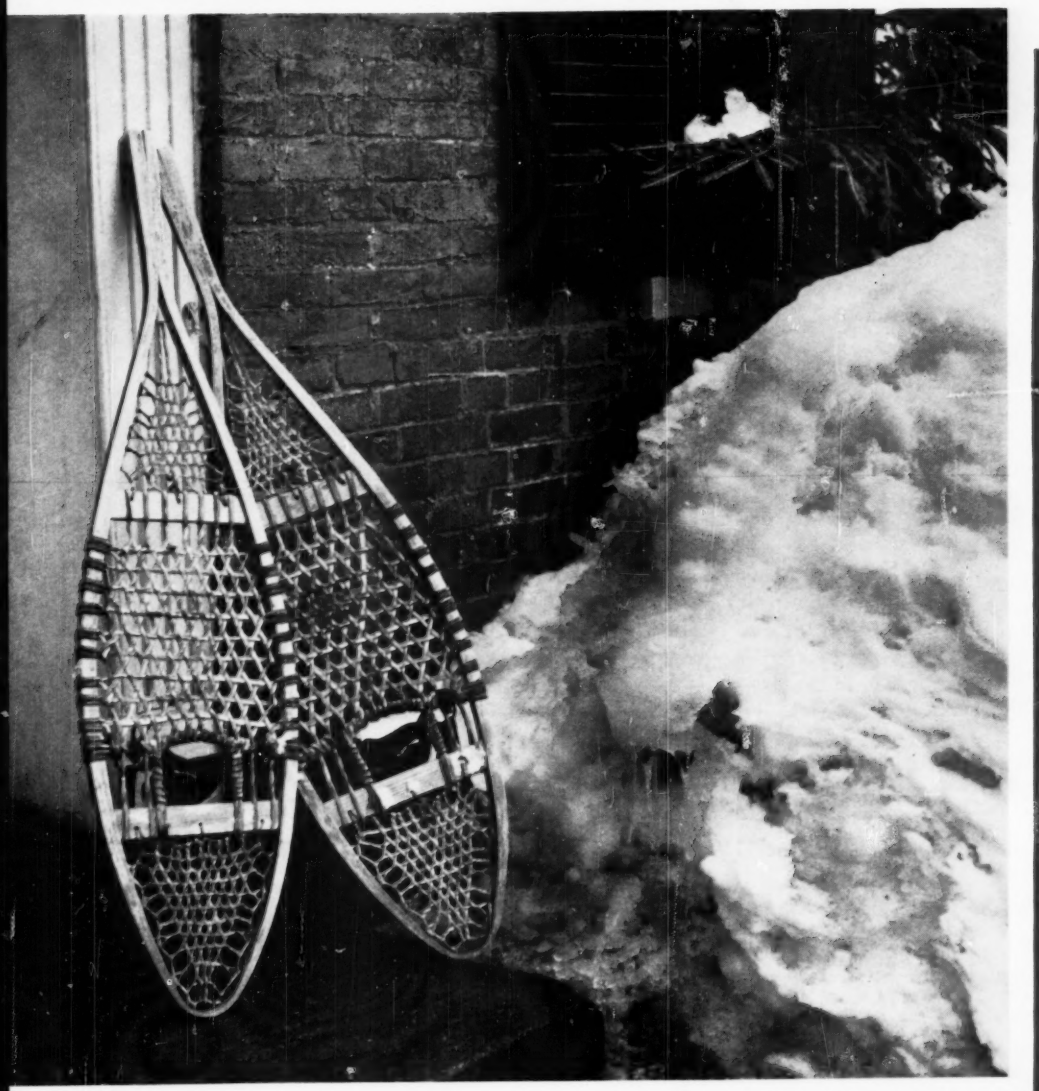
Compressed Air Magazine



DECEMBER 1960

IN THIS ISSUE:
ROCKET RESEARCH
NEW TIRES FROM OLD
AIR AND A CIGARETTE
PUMPS AND THEIR PAST
INDEX AND COVER STORY, PAGE 3

University Microfilms
313 N. 1st St.
Ann Arbor, Mich.
739-A-21

Select from full lines to operate and control a single OEM product . . . or a plant's entire production line!

Schrader means quality . . . in complete lines of double-acting and single-acting cylinders in a variety of sizes . . . including JIC and miniature cylinders. Schrader Air Cylinders . . . as well as complete lines of Valves and Accessories . . . are at work on many OEM products and in thousands of plants performing countless jobs. Your Schrader Distributor is fully stocked . . . staffed with experts to help you solve any air circuitry problem.

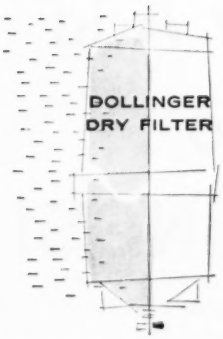
The complete range of sizes and types of air circuitry products is stocked and cataloged by your Schrader distributor. Consult the yellow pages or write Schrader.

Schrader®
a division of SCOVILL

A. SCHRADER'S SON
Division of Scovill Manufacturing Company, Incorporated
478 Vanderbilt Avenue, Brooklyn 38, N. Y.

QUALITY AIR CONTROL PRODUCTS

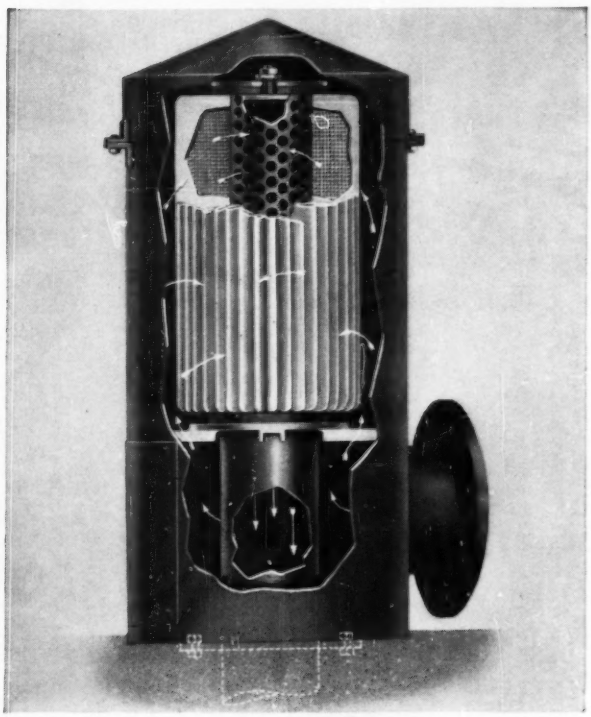
University Microfilms



SPECIALISTS FOR 39 YEARS

EFFICIENT HIGH-LEVEL AIR INTAKE AT LOW MAINTENANCE COST

Filters for internal combustion engines, compressors and blowers



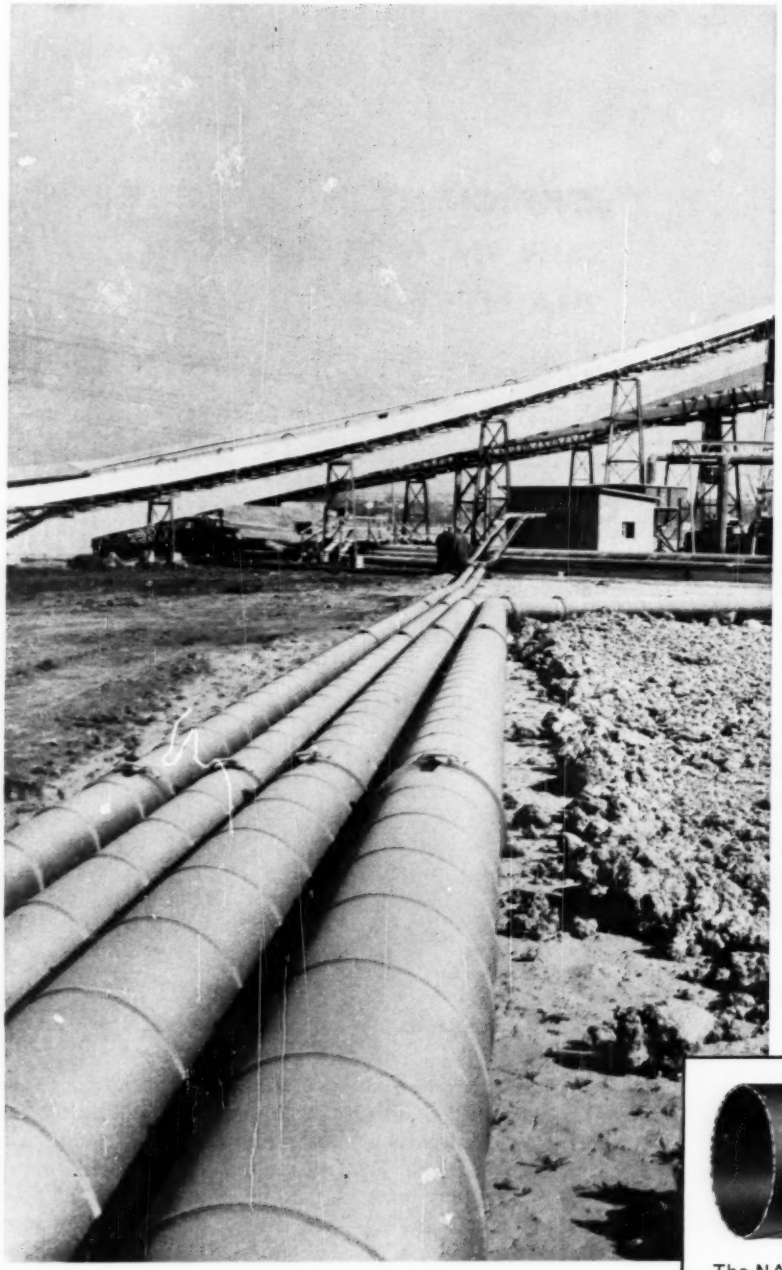
Dollinger Staynew Intake Filters (Model IDR) are of the totally enclosed, ground level type, providing the advantages of high level air intake and low maintenance cost. Exclusive Radial Fin Insert offers ideal combination of high efficiency, long life and low resistance to air flow. Removal of housing cover permits easy access to interior of filter for simple, safe inspection; piping need not be disturbed. Model IDR filters give positive protection without depending on carefully-held maintenance schedules, high velocity impingement of dust, or temperature. Available in capacities from 350 to 5700 C.F.M. Multiple units available for larger capacities. All sizes have flanged inlet and outlet connections. Write for Intake Filter Bulletin 100. Dollinger Corporation, 7 Centre Park, Rochester 3, New York.

PROTECTOMOTOR

STAYNEW FILTERS

DOLLINGER

LIQUID FILTERS • PIPE LINE FILTERS • INTAKE FILTERS • HYDRAULIC FILTERS • ELECTROSTATIC FILTERS • MIST COLLECTORS • DRY PANEL FILTERS • SPECIAL DESIGN FILTERS • VISCOUS PANEL FILTERS • LOW PRESSURE FILTERS • HIGH PRESSURE FILTERS AUTOMATIC VENTILATION FILTERS • NATURAL GAS FILTERS • SILENCER FILTERS



They Add Up to SAVINGS!

NAYLOR Spiralweld pipe and Wedgelock couplings offer you a combination that can save you time, work and money on lines in construction service.

Any way you look at it, the light weight of NAYLOR pipe makes for easier handling . . . faster installation. And, thanks to the distinctive NAYLOR lockseamed-spiralwelded structure, there's no sacrifice of strength and safety in the line.

Wedgelock couplings contribute to savings by simplifying and speeding connections. A hammer is the only tool required to connect or disconnect them.

That's why it will pay you to consider the performance of this pipe and coupling combination for your lines in air, water and ventilating service.

To get details, write for Bulletin No. 59 today!

The NAYLOR Wedgelock coupling makes a positive connection, securely anchored in standard weight grooved ends.

NAYLOR PIPE *Company*

1245 East 92nd Street, Chicago 19, Illinois

Eastern U. S. and Foreign Sales Office: 60 East 42nd Street, New York 17, N. Y.

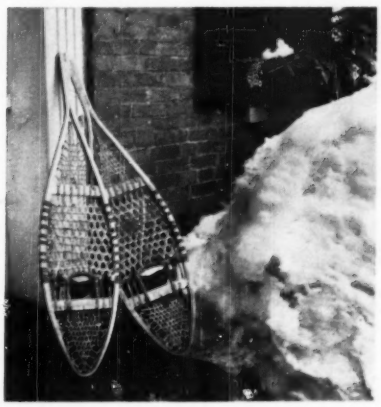
Volume 65 Number 12

December 1960

Compressed Air MAGAZINE

R. J. Nemmers, Editor
S. M. Parkhill, Associate Editor
G. R. Smith, Assistant Editor
C. H. Vivian, Contributing Editor
D. Y. Marshall, Europe,
243 Upper Thames St.,
London, E. C. 4, England
J. C. Heaslip, Canada
800 Birks Building
Montreal 2, Quebec
R. W. Sapora, Manager
J. J. Katarba, Business Manager
E. G. Andrews, Advertising Manager
R. D. Dungan, Jr., Circulation Manager

BPA Editorial, advertising and publication offices: 942 Memorial Parkway, Phillipsburg, New Jersey. Copyright © 1960 by Compressed Air Magazine Company. All rights reserved. Annual subscription, United States and possessions, $5; foreign, $7; single copies, domestic $0.50, foreign, $0.70. Compressed Air Magazine is indexed in Industrial Arts Index and in Engineering Index. Microfilm volumes (1940 to date) are available from University Microfilms, Inc. Published monthly by Compressed Air Magazine Company: A. W. Loomis, President; L. C. Hopton, Vice President; C. H. Biers, Secretary-Treasurer.



on the cover

There are few occasions that carry so much meaning to so many as the December holidays. Snow scenes, in the Northern Hemisphere at any rate, are part and parcel of the nostalgia and emotion of this season. We think that the cover picture captures a great deal of the flavor of what is usually referred to as a "good old fashioned" holiday. With it we would like to take this opportunity to wish our readers pleasant and happy associations this season, and a bright and successful New Year!

8 **Rocket Research in a Tube—** Henry M. Karaszewski

Proving a rocket's design before actually building it and hurling it into space is the job of a comparatively small wind tunnel. Designated a "hot shot," the tunnel generates extremes of speed and temperature to aid the free world's missile work.

12 **New Miles from Old Tires**—R. J. Nemmers

Putting new treads on old tire carcasses results in a safe and inexpensive set of "shoes" for the horseless carriage. Here is a look at modern methods of retreading that make extensive use of compressed air.

16 **The Commander**

Though the new cigarette interests smokers, the Mark VIII that produces it is also making history. This machine handles tobacco—from its loose shredded state to the semifinished rod—with air power.

17 **A Bow for the Hunter**

Pneumatic press and electronic curing produce better laminated bows for archers

18 **Moles Honor Brown and Immerman**

Construction group's annual awards announced.

20 **The Story of Pumps**—George V. Shaw

The history of these liquid moving devices through the ages is told here, including their modern uses in major industries.

26 **Automotive Compression Brake**

Wrought stainless steel has given way to a cast alloy steel in a valve flapper and manifold. The advantages of this change in production are described.

Departments

18 **This and That**
25 **Editorial**—Inventory
27 **Saving With Air Power**
Twisting Transformer Leads
Spraying Epoxy Resins
92 **Industrial Notes**
35 **Index to Advertisers**

MATCH THE COMPRESSOR

to your LOAD-AREA requirements

Now you can get a GYRO-FLO portable compressor with the right combination of space, weight and power for any operating conditions

1. For METROPOLITAN AREAS

it's the Power-Takeoff unit

This super-compact Gyro-Flo compressor, for direct or belt drive from the service truck power-takeoff, is ideal for busy metropolitan areas where truck size must be kept to the minimum. These 85-cfm and 125-cfm compressors take less than 3.6 and 4.9 sq ft of floor space respectively, leaving plenty of extra space for men and equipment. Air-operated engine speed control and combination air receiver and oil separator can be mounted wherever convenient.

2. For SUBURBAN AREAS

it's the Self-Powered Truck-Mounted unit

Where larger service trucks can be used and space is less critical, self-powered 85-cfm and 125-cfm Gyro-Flo compressors for truck mounting offer the advantages of maximum fuel economy, simplicity of operation and reduced wear and tear on the truck motor. There are no gears, clutches or belts and the compressor can be removed to free the truck, if necessary, when only the compressor is needed on the job.

3. For OUTLYING AREAS

it's the Completely Self-Contained Portable unit

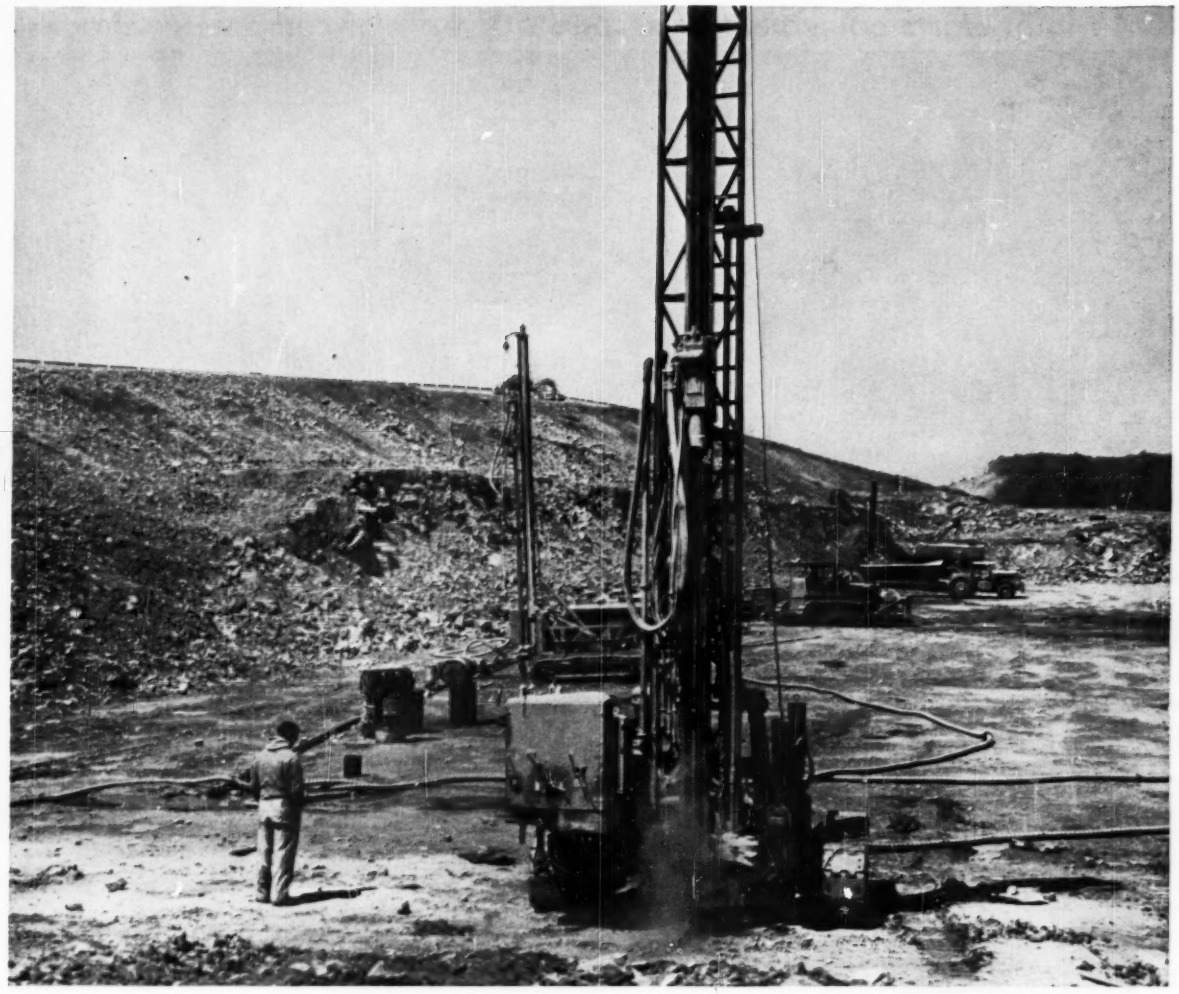
Where there's ample room for needed equipment at the job site, the completely self-contained Gyro-Flo portable compressor offers maximum convenience, flexibility and economy. You can tow it to the job and immediately release the truck for other work. Wheeled units are available in sizes from 85-cfm to 900-cfm, to meet any air power requirements.

Ask your Ingersoll-Rand Distributor or engineer for complete information on the Gyro-Flo that will meet your needs to best advantage.

Ingersoll-Rand

196A2 ♥ 11 Broadway, New York 4, N. Y.

The World's Most Comprehensive Compressor Experience



Blast Holes on Jugtown Mountain Drilled with Bethlehem Hollow

These drilling machines, equipped with Bethlehem Hollow Drill Steel, are putting down blast holes in gneiss in a man-made canyon atop Jugtown Mountain, in western New Jersey. The project is part of Interstate Route 78, which, in New Jersey, will be a high-speed freeway from the Holland Tunnel to the Delaware River, at Phillipsburg. The contractor is Yonkers Construction Company, Yonkers, N. Y.

Bethlehem Hollow is a top-quality steel, one that's ideal for every type of rock drilling. You can depend on it for economy and long service life. It comes in Carbon and Ultra-Alloy grades in rounds, hexagons, and quarter octagons, and in popular lengths from 18 ft to 27 ft. For economical drilling, specify Bethlehem Hollow.

Steel

for Strength
... Economy
... Versatility

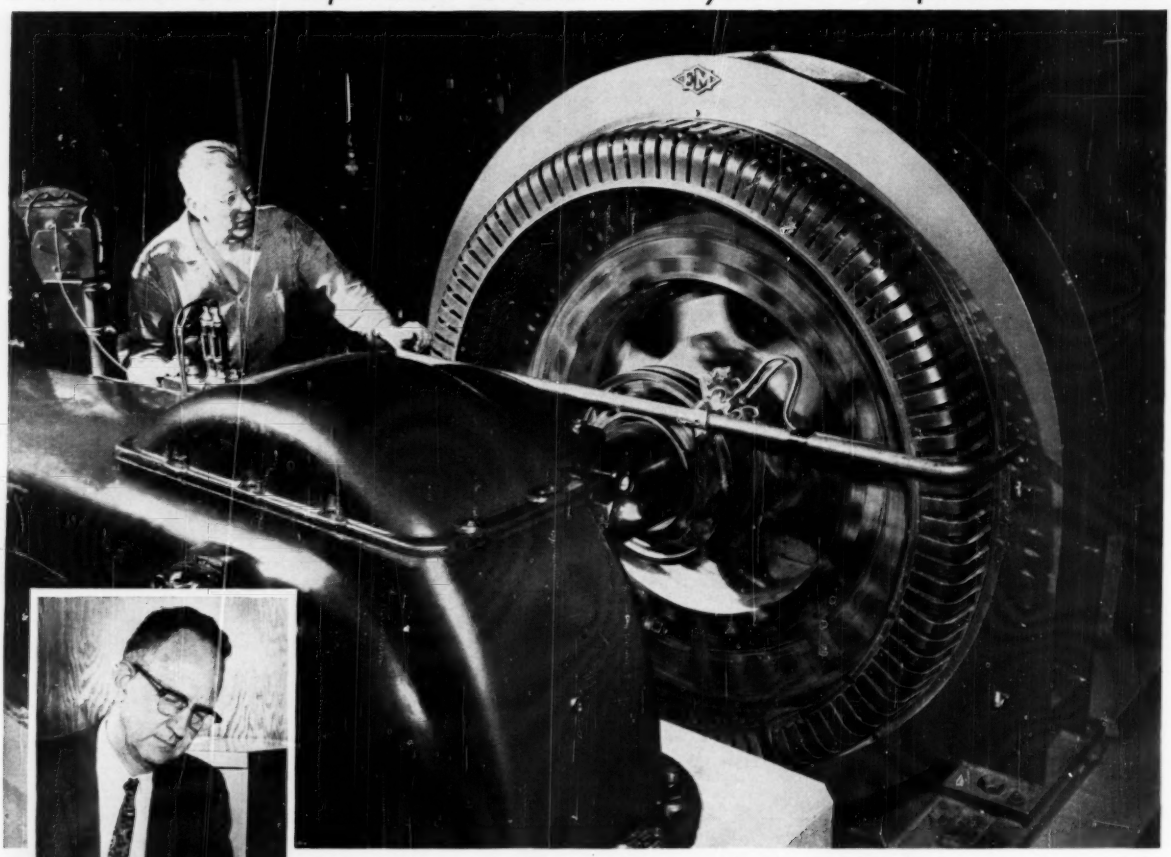
BETHLEHEM STEEL COMPANY, Bethlehem, Pa.

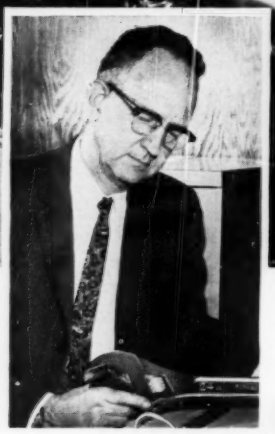
Export Sales: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL

E-M Motor starts equivalent of second 50 years of compressor service!





After running approximately 108,000 hours, this E-M Synchronous Motor is still on compressor duty at Diamond Tool and Horseshoe Co. Contributing to the remarkably long life of the motor was the careful attention of Mr. J. Gordon Mitchell (above), Diamond Tool's electrical maintenance man. The motor is rated 350 hp, 200 rpm, 1.0 PF, 440 volts.

Mr. Hampton Connell, Vice President, Engineering, of Diamond Tool and Horseshoe Co. His company recently celebrated its 50th Anniversary as a manufacturer of hand tools and drop forgings.

"We just can't seem to wear them out!"

Diamond Tool and Horseshoe Co. of Duluth, Minnesota has an E-M Motor on compressor drive that has been running for the equivalent of *40 hours a week for over 50 years—approximately 108,000 hours!* Yet this same motor is still in service 16 hours a day.

Mr. Hampton Connell of Diamond Tool tells this unsolicited story about his untiring E-M Motor:

"This particular motor was installed about 1942, and was in service 24 hours a day, 7 days a week during the last war. Following the war we operated this unit 24 hours a day, 5 days a week for a considerable period of time. For the past several years we have been running the machine 16 hours a day, 5 days a week.

"We have been using E-M Motors in our factory on our air compressors for a good many years now, and with very satisfactory results."

E-M Motors have earned a reputation for reliability and endurance in many industries. Get more information about them. Call your nearby E-M Sales Engineer and write the factory for free Compressor Number of E-M *Synchronizer*.

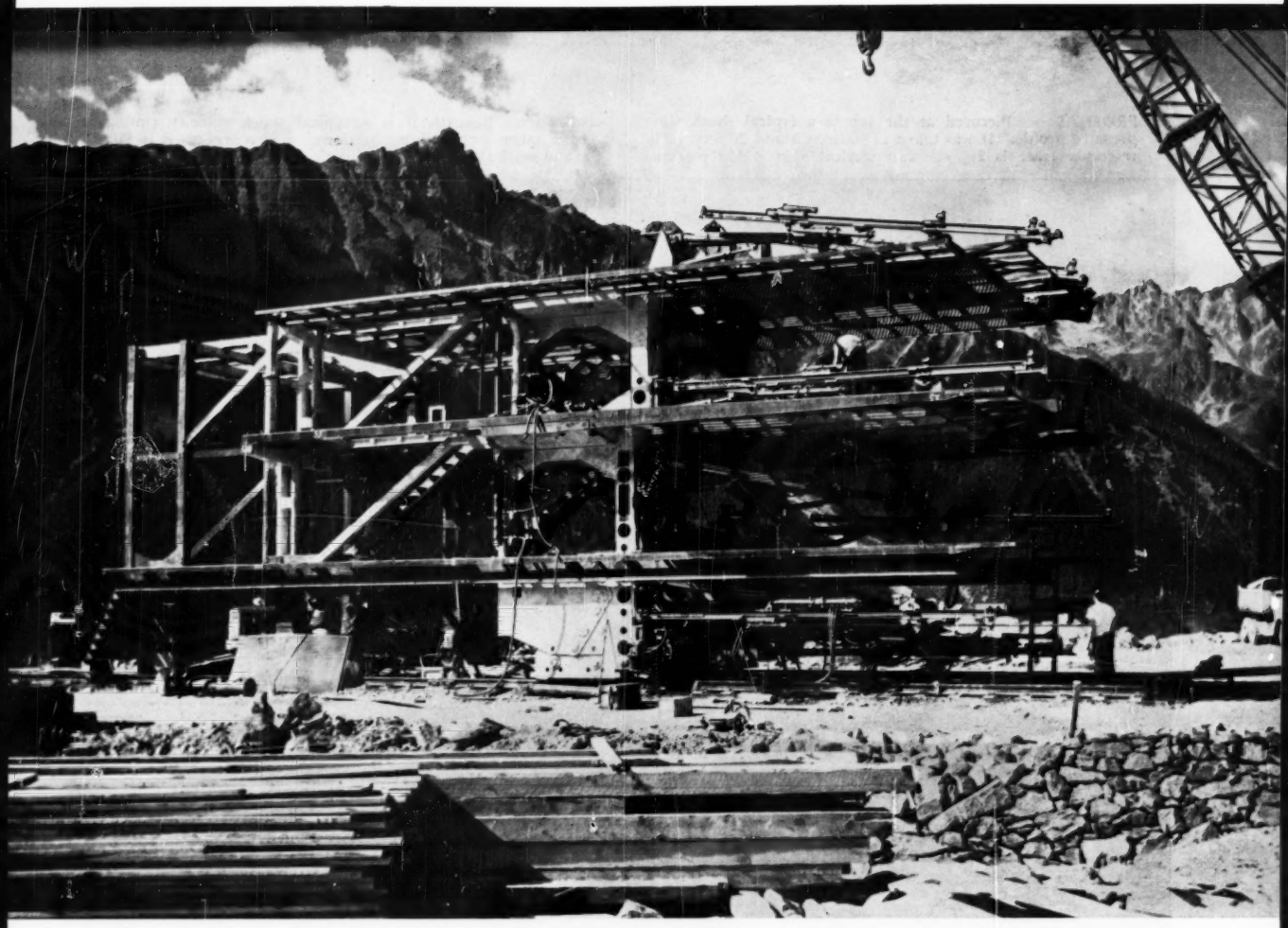
ELECTRIC MACHINERY MFG. COMPANY

MINNEAPOLIS 13, MINNESOTA

E-M

1200-TPA-2214

***Specialists in making motors do* EXACTLY WHAT YOU WANT THEM TO**



15-Drill Hydra-Boom Jumbo at MONT-BLANC TUNNEL

Fully mechanized I-R tunneling rig spearheads drilling from French side of new vehicular bore through the Alps

Using one of the largest and most modern boom jumbos ever built, the French side of the new Mont-Blanc tunnel got off to a fast start with workmen waging a winning battle against Europe's highest mountain. Completion by a group of French contractors, headed by Entreprises de Travaux Publics André Borie, is expected on schedule in 1962.

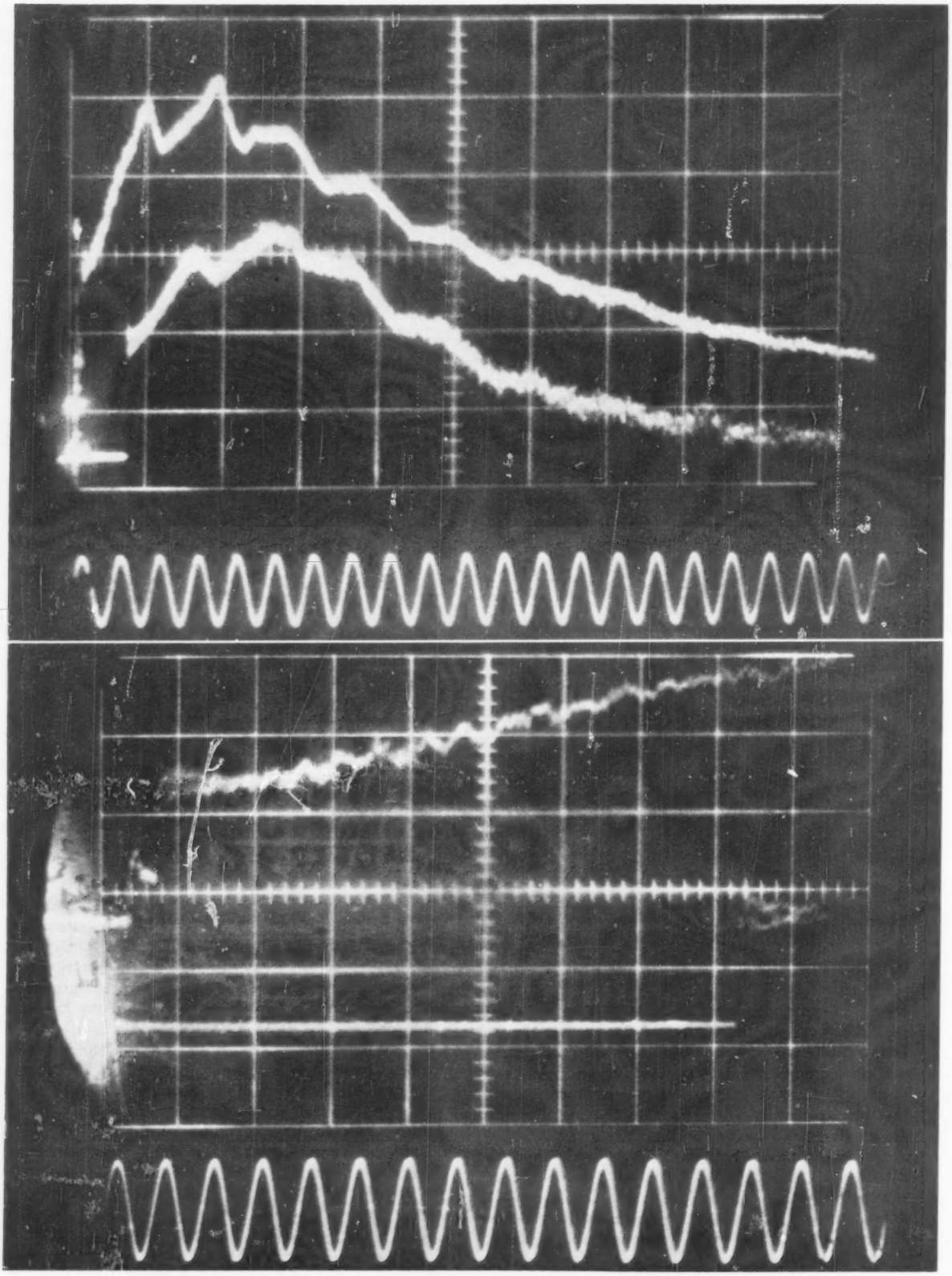
The huge four-level gantry-type jumbo mounts fifteen 3½″ bore I-R drifters on I-R Hydra-Booms that provide complete hydraulic positioning for all drills. It was built in Lyon, France, by Ferrand & Frantz, and Entreprises de Travaux Publics André Borie. Fourteen-foot blast holes are drilled without steel changes, using 1¾″ Carsets bits. A burn hole is put in each round by an I-R Downhole Drill with an 8″ Carset bit, to permit pulling longer rounds. The hydraulic cylinders of all 15 Hydra-Booms are operated from 5 hydraulic pumps driven by I-R air motors.

Wherever fast, effortless hole spotting is required for tunnel or mining operations, I-R Hydra-Booms, drifters and feeds provide a cost-cutting combination that pays off in faster, more efficient drilling. Ask your Ingersoll-Rand engineer for complete information.

Ingersoll-Rand
105A5 11 Broadway, New York 4, N.Y.

A CONSTANT STANDARD OF QUALITY IN EVERYTHING YOU NEED FOR DRILLING ROCK

PROFILES Pictured at the top is a typical shock wave pressure profile. It was taken at stations 5 and 20 feet. The reference trace is 200 cps and vertical gain is 150 psig per centimeter. Beneath it is a typical shock velocity timing record taken at the same stations. Reference trace is 200 cps and vertical gain is 150 psig per centimeter.



Rocket Research in a Tube

As further proof that the use of compressed air is unlimited, engineers of Aero & Propulsion Sciences Laboratory at Norair Division, Northrop Corporation, Hawthorne, Calif., are using pneumatics in a unique way. They have been operating a shock tube to achieve simulated speeds and temperatures that would be encountered in hypersonic flight conditions.

Henry M. Karaszewski

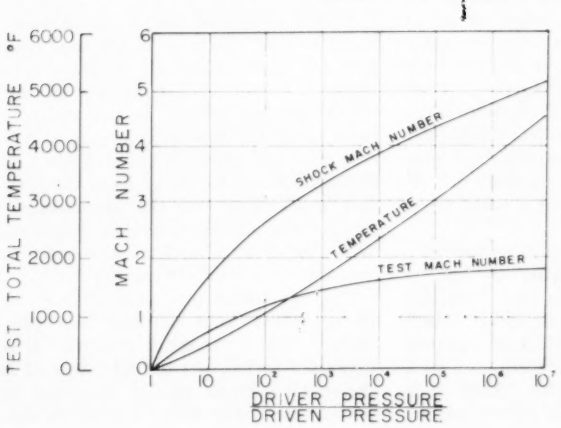
TO DESIGN a vehicle that would be able to withstand the heat generated by air friction during flights at hypersonic speeds, it was first necessary to devise an experimental instrument that would simulate expected velocity and heat conditions. It was realized that a missile operating at velocities six times the speed of sound and at an altitude of 37,000 feet would be exposed to temperatures of 2790° F—which is only 5 degrees lower than the melting point of iron. It was also known that a gas, which at normal temperatures is an electrical insulator, becomes a good conductor at these high temperatures. The need for studying these phenomena became apparent and the building of the shock tube was authorized.

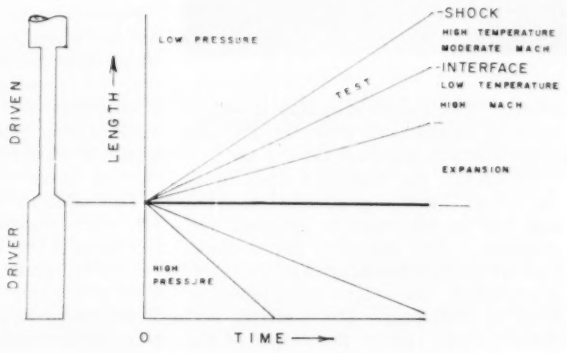
A shock tube is a "tool" that contains two gases. These are held at different pressures and are separated by flat-disk diaphragms. When the diaphragms are ruptured, a flow is generated. An expansion wave travels into the high-pressure gas section while a shock wave travels into the low-pressure area. This flow is of exceptionally short duration and contains waves of finite amplitude separated by quasi-steady regions. The shock wave, as it penetrates the low-pressure gas, heats the gas. This develops an extreme range of flow temperatures. These temperature conditions are vital in studies of space vehicle design. A few of the effects produced in gases at these high temperatures include ionization, radiation, dissociation, electrical conductivity, condensation effects, heat transfer spectra, and shock loading of structures.

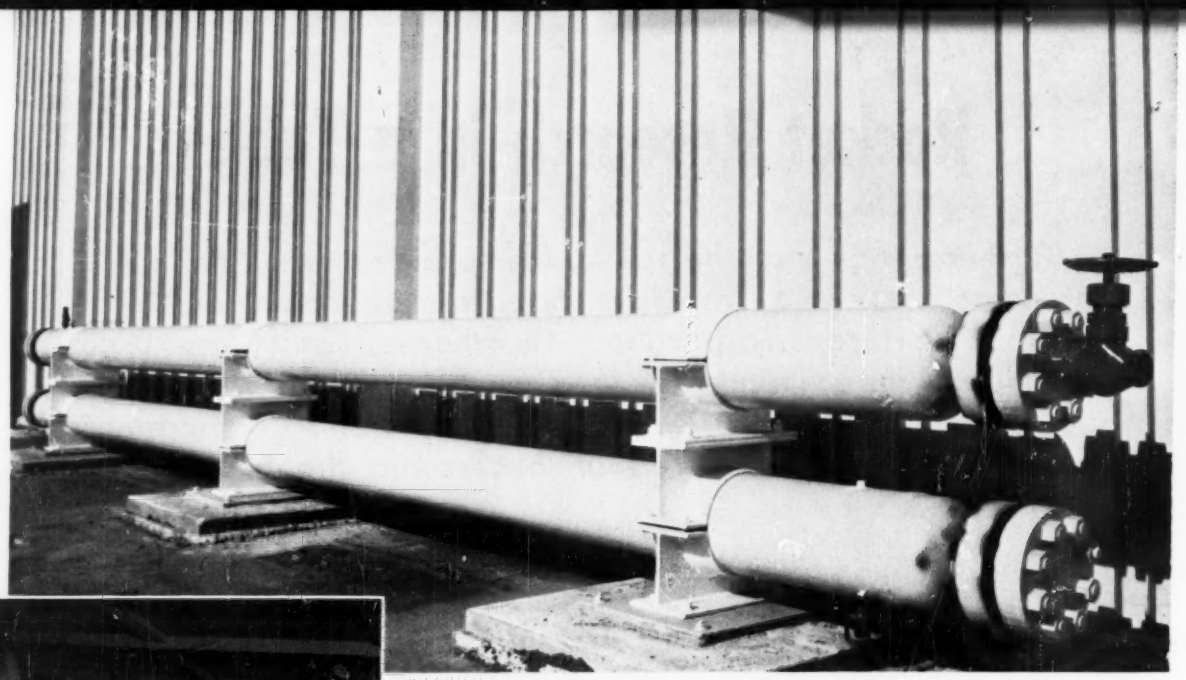
The Northrop shock tube consists of a Driver Tube (a high-pressure tank), a Driven Tube (usually pumped to an extremely low pressure), an Interspace (where, in this case, two diaphragms are located), and a Receiver.

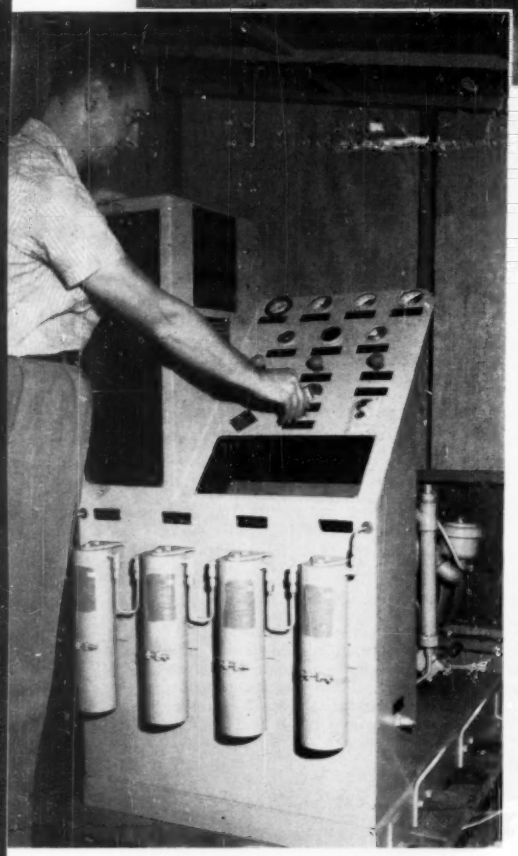
High-pressure air required in the Driver Tube is supplied by an Ingersoll-Rand 4R15M compressor. It is a 4-stage, 4&2$^{1}/_{2}$&$^{1}/_{8}$&$^{1}/_{2}$x1.8-inch unit with a rated capacity of 15 cfm and pressure of 5000 psig. Coupled with an 18-cubic-foot storage-capacity system, it provides constant operation without delays in pumping up the pressure for each test. Furthermore, automatic controls allow the unit to operate completely unat-

GRAPHS **Below left is a plot graph showing Shock Mach Number, Test Mach Number and Temperature versus the driver-to-driven pressure ratio—the quotient of the pressure in Region 4 and Region 1. (See drawing on page 11.) The Shock Mach Number and test-flow total temperature increase steadily as the pressure ratio increases. The graph at the right presents an x-t or distance-versus-time diagram. As time increases (to right), a shock face moves down the tube followed by an extremely high temperature-moderate Mach number flow. This is the test region. Following the test flow is an interface and a low temperature-high Mach number region of very short duration, and an expansion fan.**









COMPRESSOR AND STORAGE At the left is the author standing by an Ingersoll-Rand 4R15M, 5000-psig compressor and control console. The 4-stage unit is completely automatic and does not require an operator except for starting and stopping. High-pressure air flows through a mechanical filter, two desiccant chambers, and an oil vapor filter prior to entering storage bottles, shown above. Each bottle has a 9-cubic-foot capacity at 3850-psig pressure. The high-pressure valve shown is used in purging the system. The storage system, as well as all other units, is designed for easy expansion should such be required in the future.

tended. The system is equipped with a series of mechanical, desiccant and oil vapor filters that assure very dry air.

To operate the Northrop shock tube, the Driver Tube is pressurized to 3500 psig, and the Interspace to 1800 psig (*see diagram*). This equalizes the pressure load across both diaphragms in the Interspace, for the diaphragms are designed to burst at 2400 psig. The Receiver and Driven Tube (where the model of the space vehicle to be tested is mounted) are pumped down to 10 microns Hg absolute (0.000193 psia). When a trigger valve is opened, high-pressure air enters a necked-down diaphragm section. The diaphragms are ruptured. Rupturing is accomplished solely by air pressure; a commonly used puncturing device is unnecessary.

Pressure impulses generated by this burst of air travel into both the high- and low-pressure regions. The resulting waves injected through the low-pressure section coalesce to form the shock wave. This wave is followed down the tube by the contact surface (the traveling interface between the original high- and low-pressure air masses). The contact surface moves at a lower rate of speed than the shock wave itself. The air in front of the interface adjusts by a normal shock formation and moves further ahead of the interface as it passes down the tube.

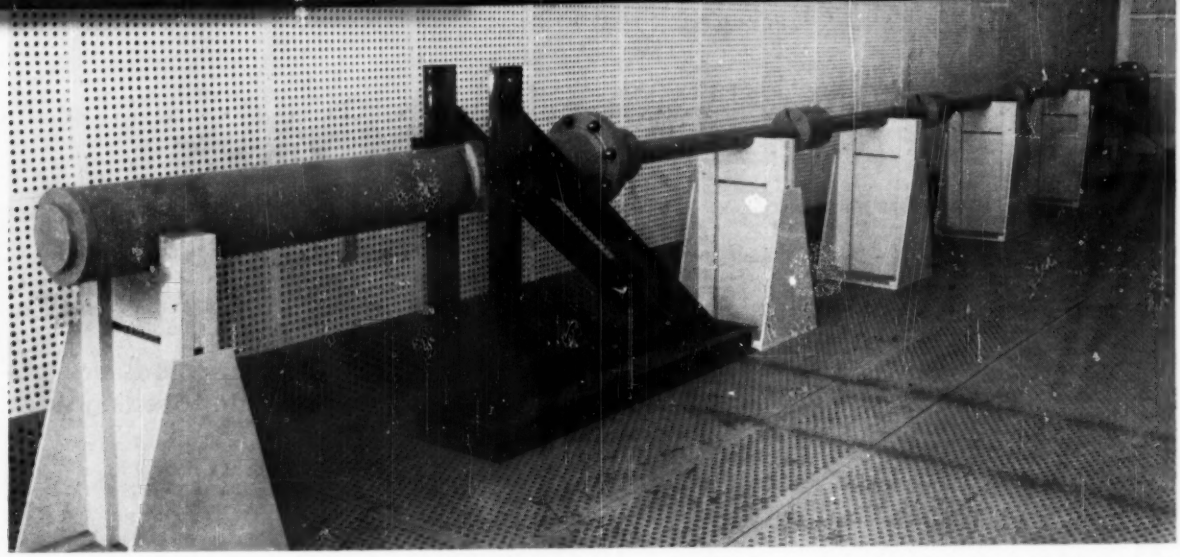
Phenomena produced in a shock tube are, by nature, rapidly fluctuating. They are of short duration and encompass the extremes of hydromechanical conditions. Instruments used to measure these phenomena must contain extremely fast response characteristics and a wide range of sensitivities.

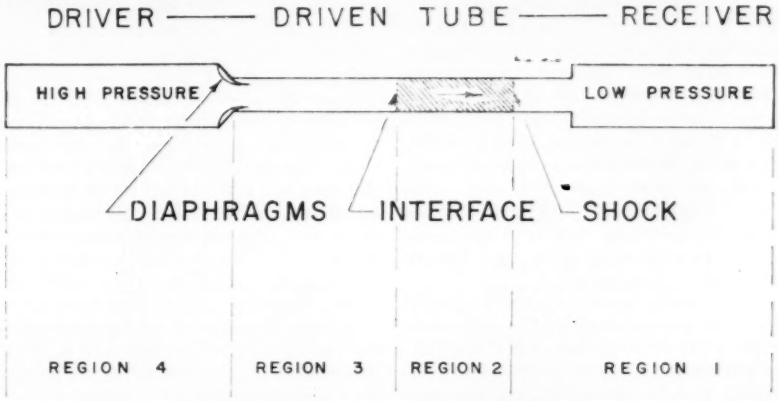
To establish velocity and pressure profile characteristics during a test, a Northrop shock tube utilizes Photocon Model 342 pressure transducers. These have a response time of approximately 50 microseconds and are capable of pressure measurements above 10,000 psig. They are used to measure Driver and Receiver pressures during the actual testing operation. They are also used for timing, for the Photocon units are flush-mounted at 5-foot intervals along the tube including the test section.

The duration of the testing region (shock front to interface) and the temperature profile of the shock front are obtained from platinum resistance film thermometers. They consist of a micro-thin platinum film from which wires are connected to indicating and measuring equipment. These film thermometers are fastened with an adhesive at the same 5-foot-spaced intervals as the pressure transducers, but are mounted 180 degrees from the pressure indicators. They are fabricated by the Norair Aero & Propulsion Sciences Laboratory and give precise data.

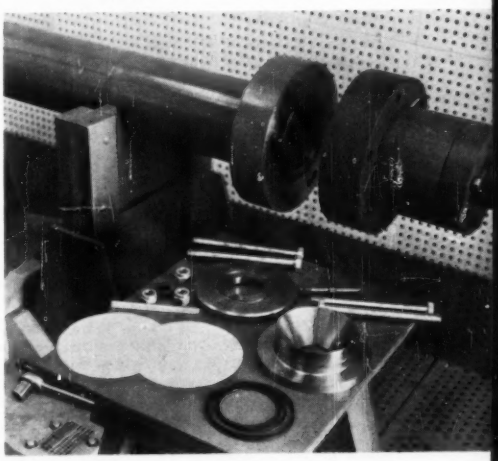
A pulse generated from a master transducer located upstream in the tube triggers the pairs of sensing media downstream. The output from any of the paired sensing devices at any two stations along the tube is recorded with a reference sine wave. (This is known as sweep timing.) Readings from the pressure transducers and the platinum resistance film thermometers are displayed on an oscilloscope and are permanently recorded by a Polaroid camera.

The basic shock tube performance can be evaluated by measuring four variables. First is the shock velocity. It is expressed in feet per second. Second is the shock pressure profile, measured in pounds per square inch. The shock tem-





THE TUBE Above is the Driver Tube section from the Receiver shown during initial calibration. At right is a close-up view of the Driver section (to the left in the photograph), and exposed for viewing is the necked-down section where the diaphragms are normally located. The line drawing is of the Norair shock tube. Region 4 is compressed to 3500 psig, while Region 1 is evacuated to 10 microns Hg. Double diaphragms (shown burst in the figure) separate these two regions. Following the bursting of the diaphragms, flow Region 2 moves down the tube behind the shock front, while flow Region 3 moves down the tube behind the Interface. Region 2 is the test region.



perature profile is third, and is read in degrees Fahrenheit. The fourth variable is the testing time duration.

Special test instrumentation is used to collect those data from the model that are of aerodynamic concern—that is, forces, pressures and temperatures. Because each test is of such short length, all information must be gathered within milliseconds. To do this, new theories and methods of data gathering had to be developed.

In standard aerodynamic testing, great forces may be exerted for long periods of time. In these tests, models are rigidly restrained in a wind tunnel. In the shock tube, however, and again because of the brevity of the testing cycles, the models are sometimes spring-mounted so that the forces may be measured along with pressures and temperatures. Minute accelerometers, with specially calibrated frequency response, are mounted within the model. They are oriented so that they will relate the output to the aerodynamic load exciting them. With this system, the aerodynamic forces can be measured within the short-duration testing periods.

Pressures on the model itself may be measured with rapid-responding miniature transducers that are installed within the model. (The models are fabricated from Pyrex, plastic or some material of specially high thermal sensitivity. Since the run duration is short, all testing of the models is done on a nondestructive basis when using cold driver air.) These transducers are specially designed and fabricated at Norair. Barium titanate crystal is utilized as the sensing medium.

Heat transfer data are obtained by applying platinum resistance film thermometers of 4-micron thickness directly to the outer skin of the test model. Even though microsecond-responding instrumentation techniques are utilized, sufficient data can still be gathered to permit the study of heat generation in various aerodynamic designs. These results are then evaluated, enabling re-entry and heat transfer problems to be solved well in advance of costly tooling and/or full-scale production.

Much thought is presently being given to see if the velocity and temperature ranges of the Northrop shock tube can be extended. Conferences are being held with Ingersoll-Rand and Western Air Compressor Company to convert the 4R15M 4-stage air compressor into one that uses light gases instead of air as the shock tube pressure source. By using such light gas drivers as helium, and/or heated drivers with a modified test section, temperatures as high as 10,000° F and velocities of Mach 20 may be achieved. Such temperatures are nearly twice the melting point of tantalum.

Further, studies are being conducted to allow compression of more exotic gases such as hydrogen/helium and oxygen, pressurized to 10,000 psig. This would permit the Driver Section to be "loaded" with a calculated combustible mixture at a pressure of 8000 to 10,000 psig. Exploding this gas would produce a Driver pressure to 100,000 psig and a resultant test Mach number of 25 to 35.

rubber in place until the vulcanizing is

New Miles from Old Tires

Long the workhorse of tire retreading shops, compressed air (and vacuum, too) are put to work in new equipment that improves quality as well as lightening and speeding work

R. J. Nemmers

AN ARTICLE in the January 1940 issue of *Compressed Air Magazine* began, "Most of us can remember when automobile tires had a very short life. The tread wore away fast; but, even so, few tires remained intact long enough for the tread to be reduced very much. The structure was weak, and blowouts were common. Once the tread was worn thin, however, little could be done for it. Times have changed now and tires are made sound enough structurally to stand retreading or recapping."

That article was even more prophetic than the editors realized. In only a few months we were embroiled in a war that virtually cut off all natural rubber supplies. For the average citizen, new tires were impossible to buy, and the business of tire retreading got a lift that has substantially carried over in the years since. People found that properly done retreads could safely stand up to heavy loads and give service well worth their cost. In the years since, improvements in rubber and methods have resulted in a product that retreaders—hardheaded business men—will often guarantee to last as long as did the original tread.

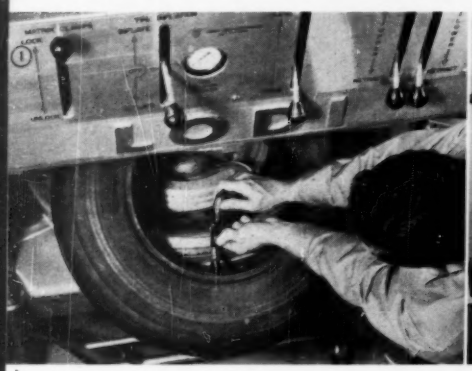
The economics of tire retreading are quite simple. Their cost is just under half the price of a new tire for passenger cars. For trucks—with their heavier ply tires—the cost can be as little as one-quarter the price of a new one. It is significant that truck operators, conscious of all costs including the high charges attributable to a truck stalled on the road, are firm supporters of retreads and often will have a single casing rebuilt two, three, even four or more times.

Although, so far, we have used the terms *recap* and *retread* interchangeably (as do most laymen) there is a difference. In *retreading*, all of the old rubber tread is removed almost to the fabric plies. The carcass is then built up with new rubber to its original dimensions. In *recapping*, very little rubber is removed. All that is done is to buff the surface of the old tire to expose sufficient clear rubber to provide a satisfactory vulcanization interface. Then, a thin strip of rubber is wrapped around the tire to provide the necessary bulk for a new tread. The majority of tire rebuilding today is retreading in its strict sense, yet the public—depending somewhat on the part of the country—frequently refers to the completed tires as recaps. People in the trade, too, sometimes refer to retreading as "full capping," and recapping as "top capping."

Although the statement has often been made that only tires without a break or cut of any kind are suitable for good retreads, carcasses with relatively large cuts have been successfully restored. The retreader's experience and integrity are important adjuncts to his judgment of what constitute. a recappable tire. In general, cuts, bruises and breaks on the side walls are considered to be limiting factors: the relative thinness of the carcass there, plus the constant flexing under load, work against successful service.

The basic steps in retreading a tire are well known. First the carcass is buffed to a suitable contour. Small cuts and breaks, if any, are then repaired with suitable patches, and the carcass is sprayed with liquid rubber cement that acts as an adhesive to hold tread rubber to the tire. Tread rubber is a shaped, specially-processed rubber that includes the necessary vulcanizing aids. Actually the rubber cement is not required for vulcanizing—it merely holds the tread

PRESS SYSTEM **The Lodi P-1 system is illustrated here at the Davis & Myers tire retreading shop, Oakland, Calif. Lining the walls are the individual matrices, each in its curing station. The press itself is in the center of the room. In the series of pictures on these two pages are shown the operating steps. At (1) the built-up carcass is connected to the press inflation hose which, in a later step, will feed air to the expansible curing tube. The tire is then placed in the lower matrix half (2), and the tread centering plates extended to properly position the tire (3). At (4), the press is fully closed and the locking ring that secures the two halves of the**



rubber in place until the vulcanizing is complete.

The tire is then placed in a tread mold or matrix. Once in place, an expansible inner tube, held in place by an inside curing rim, is inflated with compressed air (at approximately 150 psig depending on the tire, the retreader and the mold) to force the soft rubber into the tread mold interstices. After "curing" for the required length of time (about an hour for passenger car tires) the tire is removed and inspected, and is ready for use.

In modern shops either steam or electric energy is used to heat the molds. Power buffing equipment that automatically buffs a tire to the correct contour is frequently seen and a variety of other power aids are in evidence. The reason is not only to cut labor and time, but also to improve the quality of the finished retread. Many of these aids are powered by compressed air. There are tire spreaders, for example, that pneumatically open the carcass to the sharp eyes of the inspectors. Air-cylinder hoists lift the heavy truck or construction-equipment tire into place and pneumatic "kick-out" cylinders help remove the finished tire from its mold. Air Impactools, of course, are used in speedily taking wheels from automobiles and trucks, and pneumatic bead breakers aid in removing tires from the wheels without damage to the rim or tire. Air-charged hold down clamps secure wheels while tires are being put on or removed.

In recent times some air-operated and vacuum equipment that directly affects the quality of finished retreads has appeared on the market and has resulted in some of the more significant changes in retread practices since the war. In certain respects the equipment presents whole new systems of tire retreading that not only reduce operating costs, but capital investment charges as well. They significantly increase the number of tires that can be turned out in a given time and also result in more uniform tires and fewer unacceptable retreads.

The new systems are products of the Super Mold Corporation, Lodi, Calif., under the registered trade name of Lodi. Super Mold has been in the business of making tire retreading equipment since 1928 when a firm of that name was incorporated in Nevada. In 1936 the company was incorporated in California acquiring all of the predecessor firm's assets. Today, with slightly more than 500 employees, it makes all kinds of retreading equipment for world-wide distribution from its two plants—one in Lodi, and the other in Stockton, Calif.

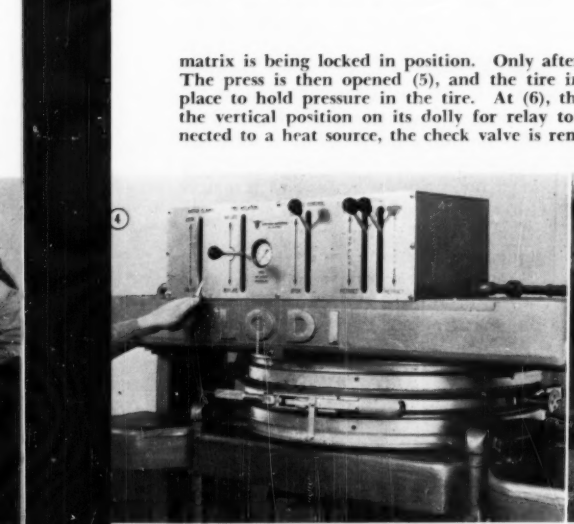
To understand the principles behind the new Lodi systems, it is necessary to review in slightly more detail some of the prevalent practices of the tire retreading industry. After tread rubber is applied, it is readily apparent that the built-up carcass has a diameter approximately equal to the finished tire. To get it into a retread matrix the same size as the finished tire, then, is a practical impossibility because of the tread pattern, unless there is some means of shrinking the tire. This was considered

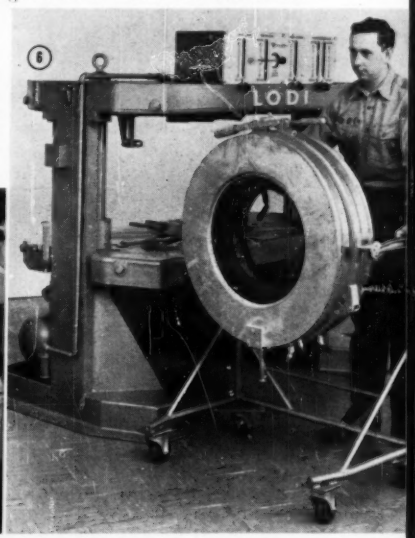
Compressor Selection

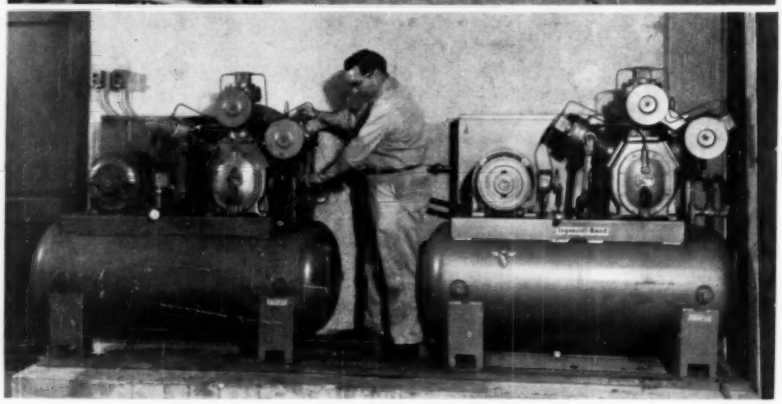
Because of the widespread use of compressed air in the average retreader's shop, a continuous-duty machine is always recommended. This calls for industrial-type valving of the units, 2-stage construction with adequate multitube intercooling, etc. Lodi engineers recommend units with separately cast cylinders, 4-ring piston construction and certain other heavy-duty features. As a guide to compressor selection in the retread shop, the table below lists average-per-minute consumption of a variety of equipment that might be in use. Those items identified with an asterisk (*) are considered to be continuously operating devices when in normal use.

EQUIPMENT	AIR PRESSURE, PSIG	AIR USAGE, CFM
2-Ton Hydraulic Lift	145–175	5.25
Pneumatic Jack	120–150	.5
Tire Changer	145–175	1.0
Tire Air Line (each)	120–150	1.5
*Tire Spreader TS-2B	180	16.0
I-R 8000 Bead Breaker	90–125	8.0
I-R 403 Impactool	90–125	4.0
I-R 308 Impactool	90–125	7.
I-R 310 Impactool	90–125	8.
I-R 334 Impactool	90–125	12.5
*Tire Spreader TS-1A	180	14.0
*Blow Gun	90–125	2.5
*P-1 Press	150	35.0
*P-2 Press	175	40.0
*BU-1 Buffer	100	2.0
*TB-1 Tread Builder	100	2.0
*Retread Mold, Pass.	120–150	5.0
*Retread Mold, Truck	175–200	8.0

matrix is being locked in position. Only after this is done is air available to inflate the curing tube. The press is then opened (5), and the tire inflation hose is uncoupled leaving a check valve in place to hold pressure in the tire. At (6), the matrix is removed from the press and rotated to the vertical position on its dolly for relay to a curing station. There, after the matrix is connected to a heat source, the check valve is removed and an air hose attached to maintain pressure.







TYPICAL SHOP Shown at the top is the Davis & Myers Tire Retreading shop in Oakland, Calif. In the center of the room is a Lodi P-1 press and around the perimeter are the many matrices used with it. Below are the two Ingersoll-Rand 15TE Type 30 compressors that supply the plant with compressed air at a pressure of 175 psig. In continuous service, a P-1 press requires about 35 cfm at a minimum pressure of 150 psig. In addition, a constant pressure must be kept against all tires while curing. Each of the compressors delivers about 65 cfm; the spare air is used in buffers, spreaders, spray guns, Impactools and the like.

impracticable for quite some time, thus the matrices were made slightly oversize. Then the entire carcass was expanded to fill the matrix. Many felt that this expansion of the tire during curing or vulcanization resulted in undesirable stresses being locked into the tire, eventually resulting in lower tire mileage.

In addition, placing the tire into an oversize form introduced the possibility that the tire might be skewed during inflation of the expansion rim and the tread thus produced might be crooked, that is, not parallel to the perimeter of the tire. Indeed, this was one of the principal trouble spots in the retreader's shop. To assure that crooked treads were not produced required considerable care on the part of the workmen, and considerable time in making the necessary adjustments and in alternately inflating and deflating the curing bag in the hope that so doing would help straighten the tire in the matrix.

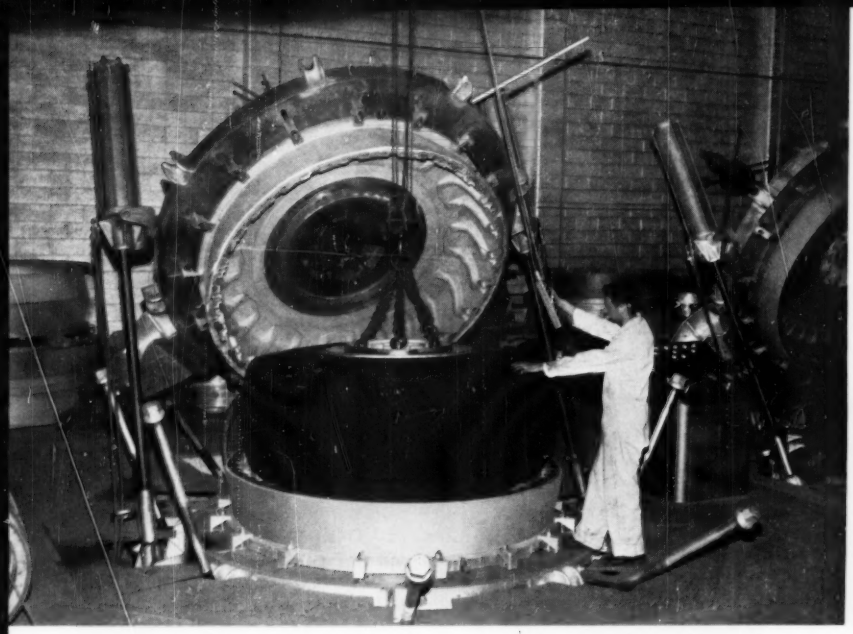
Several years ago Super Mold engineers came up with an idea for reducing the diameter of a tire mechanically so that it could be slipped into a matrix and cured in a relaxed position equivalent to the shape it takes while in use. The idea was quite simple and consisted merely of squeezing the beads of the tire together. This effectively reduces not only the cross section of the tire but also the over-all diameter. (Spreading the beads apart does the same thing by flattening the tire.) The reduction in cross section and diameter can be illustrated by nothing more elaborate than a tightly wrapped new tire familiar to every visitor to a service station. Laying one of these alongside a fully inflated tire on a wheel is enough to show the difference in dimensions. The reduction is just enough to enable the full-dimension, built-up tire to be slipped into a matrix of which the smallest inside diameter (the one at the root of the tread pattern) is essentially smaller than the tire itself. When retreading (full capping), the reduction of the cross section is also important for it prevents the side walls of the tire from premature contact (hanging-up) on the skirts of the matrix.

Holding the beads of the tire together with full circular plates also provides a satisfactory means of holding the tire during inflation of the expansible curing bag so that the tire is properly centered in the matrix. Crooked treads are thereby eliminated and a premium quality retread is produced. Users can show that they derive more mileage from retreads produced without vulcanizing distortion. Retreaders themselves vouch for the efficiency of the centering device in preventing crooked treads.

Another method of reducing tire diameters has been developed by Super Mold and it is used for wire cord tires and for fabric tires of larger diameter than can be handled by the bead squeezing equipment. It depends on vacuum. A rim is pressed into the tire and a vacuum line pulls down internal pressure thereby dimpling the tire (as shown in one of the accompanying pictures) so that it can easily be placed in its matrix.

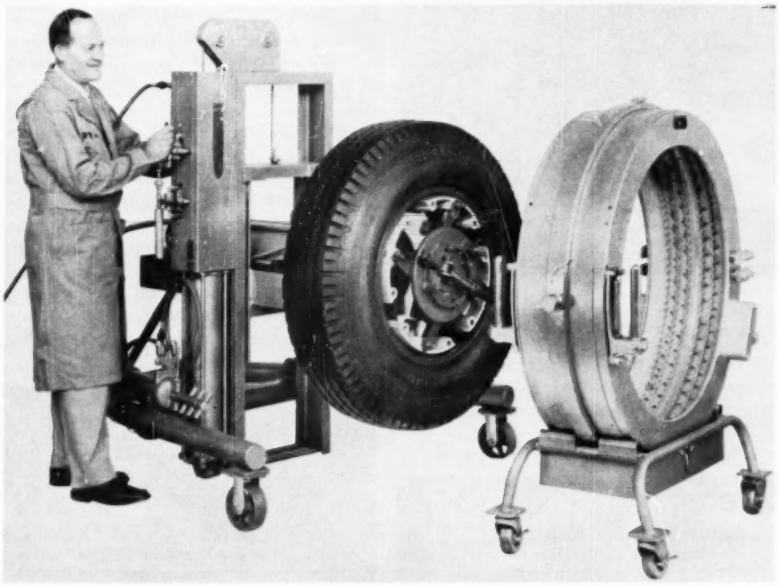
Super Mold has incorporated these basic principles of retreading into some new equipment that essentially make up entire systems of retreading. In so doing, installation costs of a given output capacity have been lowered, and the amount of space required for a given output has also been reduced. Early matrices were divided into radial sections and incorporated into the traditional heavy mold of the retread industry. With the Lodi method, radially divided forms were no longer required and this made it possible to build matrices in two circular ring halves. With simplified methods of getting the tires into the ring matrices it was no longer necessary to combine each matrix with a heavy-duty mold.

The Lodi P-1 press system, for example, provides a means of loading and locking matrices and setting them on dollies for transfer to a curing station. The matrices are turned up on edge while curing to save space, and one press can serve many matrices. Investment costs are thereby lessened not only because of space savings, but because individual molds are not required for each retread that is being cured at any given time. The P-1 system is a high-capacity machine that may be completely auto-

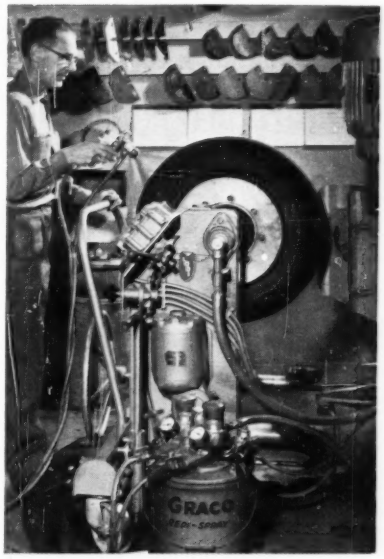


GIANTS The large-size tires used in the construction industry can also be retreaded at substantial savings. Lodi builds a range of molds covering all tire sizes and with divisible matrices and spacer rings can offer a system that requires a minimum investment in matrices for extensive coverage of tire sizes. The "T" mold shown here can handle, with appropriate matrices, tires with over-all diameters from 44 to 98 inches in all cross sections, widths and rim diameters.

DIMPLES Lodi's vacuum dimpling system is illustrated here as the operator inserts a single-ply wire cord tire into a Lodi curing mold. This particular type of tire gave its owner 100,000 miles of service before requiring work. With the Lodi nondistortion system of retreading, another 100,000 miles of wear is expected from the carcass.



BANDRIX The completely air-powered Bandrix spreader shown here is utilized to insert and remove tires from the Bandrix. Not only are the Bandrixes themselves completely portable, the inserting device can also be moved around easily within the limits of its air supply hose. Bandrixes are available with either long or short skirts for full or top capping.

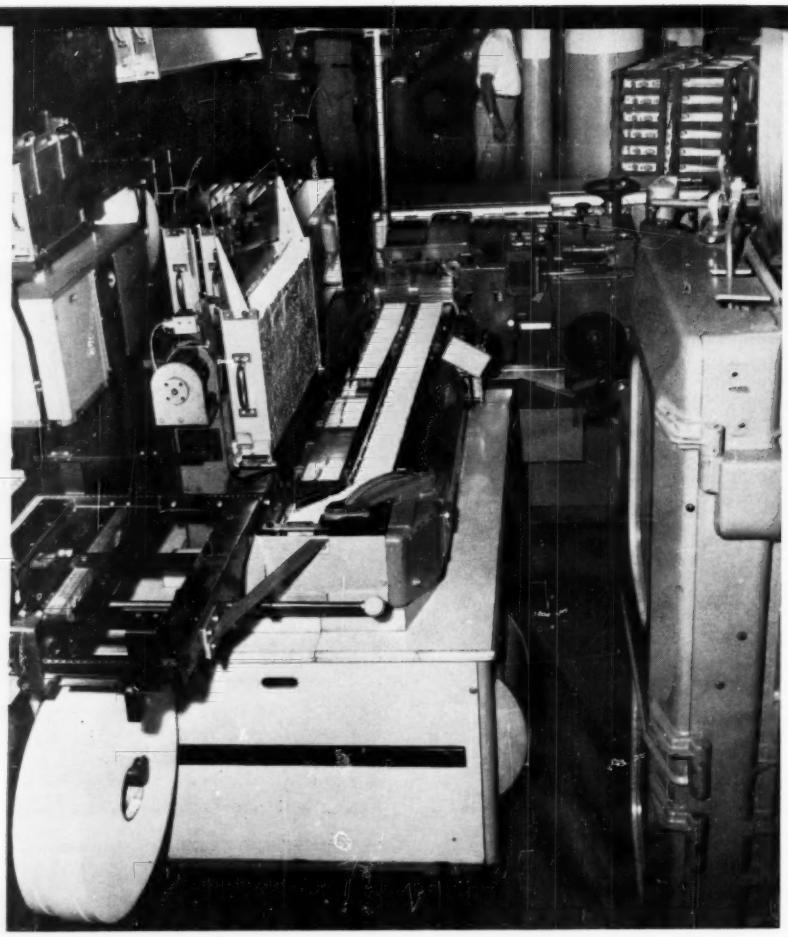


CEMENTING An air-powered cement spray gun is available from Lodi to coat buffed tires with rubber cement to hold the tread rubber in place until vulcanized. The one shown here (in conjunction with a Lodi buffing machine) operates without air pressure on the cement reservoir making it possible to use the cement shipping containers.

mated at the option of the purchaser. In the manual variety, valves thrown by hand also permit high speed. It takes about a minute and a half for an operator to unload a cured tire from a matrix and replace it with another one, remove the matrix from the press and transfer it to a curing station.

Although the high volume possible with the P-1 system makes it ideal for passenger car tires, truck tire retreading has not been neglected. Some smaller sizes, of course, can be handled on the P-1 press. Larger ones are taken care of by the P-2 press as well as the Bandrix system, both of which incorporate the same general type of matrix construction as the Lodi P-1 press system.

For even larger tires, a new vacuum system is in use in some shops. The secret is simply that by drawing a vacuum on a tire casing equipped with a tight rim, it will be dimpled and consequently reduced in size. The Lodi vacuum method, along with the P-1 and P-2 presses and the Bandrix system are illustrated with special attention paid to the various air-power features of each that make it possible for retreads to be turned out at low costs and yet of a quality that provides safe, troublefree transportation for thousands of drivers.



THE MACHINE The advanced Mark VIII equipment shown here makes Philip Morris Commander king-size cigarettes at the company's Richmond, Va., and Louisville, Ky., factories.

From High-Velocity Air Streams—

THE COMMANDER

Have a Commander . . .

Welcome aboard.

This statement, set with nautical flavor, first appeared in print and on the air last September 15. Behind it is a king-size cigarette made on an air-equipped machine. The Commander is the longest—by 5 millimeters—cigarette ever made by Philip Morris Inc. It is said to have unique body firmness as well as clean-cut, tightly packed ends—qualities that are possible because of the machinery on which these smokes are made.

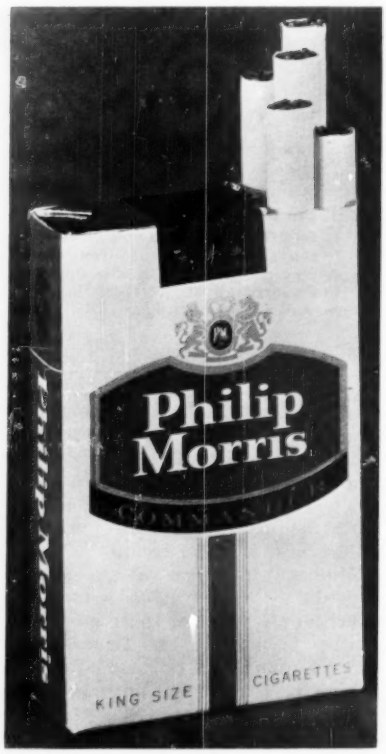
The equipment is called by the typically British sounding name of Mark VIII. It is therefore not unusual to find that it was engineered in London, England, the firm being Molins Manufacturing Company Limited. It uses a new and unique manufacturing technique that eliminates that constant headache of cigarette makers—soft spots.

High-velocity air jets create the Commander. The tobacco is under vacuum control before the cigarette paper envelopes it to form the rod of tobacco from which the individual cigarettes are cut. Vacuum action also gives the rod its consistency, and its perfect shape—which is somewhat larger in circumference than the long-size Philip Morris cigarette it replaces. The result is a firm cigarette that burns slowly giving a low-temperature smoke.

In detail, here is how the Mark VIII works. High-speed air jets deliver the tobacco up to a revolving porous tape. (Even before this, the jet vacuum cleans the tobacco by rolling every particle of the leaf in air.) In the past, the industry's cigarette-making machines used a gravity feed system to drop tobacco onto a moving belt. The continuous vacuum action of the Mark VIII holds the tobacco to the underside of the tape. This jet delivery is controlled electronically with the utmost precision.

To achieve the perfect roundness of the Commander, the tobacco is air-formed. Once it takes a coherent state, constant vacuum holds it to its initial contour. The vacuum holding the shaped rod is broken only after the partially formed paper tube has enfolded it. Therefore, the rod of tobacco cannot lose its shape as it is transferred from the porous tape to the cigarette tube. It is this constant use of air pressure on the tobacco—from its loose shredded state to the semifinished rod—that gives the Commander its solid body.

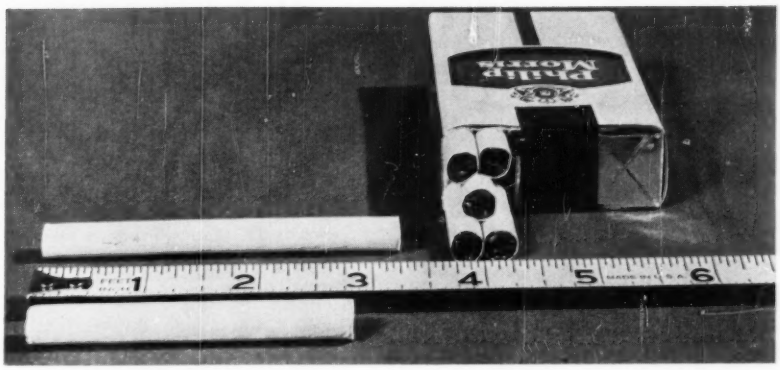
The Mark VIII is a precision machine that packs the tobacco more densely at each cutting point. This extra tobacco, combined with the clean, quick action of an extremely sharp hollow-ground cutting instrument, makes the cigarette ends as firm as the body itself. Those annoying loose tobacco particles that



THE PACKAGE Specially designed by Philip Morris and Walter Landor & Associates, the red, white and gold colored package carries the cigarette name on a band of maritime blue.

formerly always managed to stick to the smoker's tongue are said to have been eliminated.

Each of the Molins Mark VIII's is fitted with electronic weighing devices that provide an automatic and constant check on performance. These and control mechanisms that supply permanent records of each unit's operation are part of Philip Morris Inc.'s quality control program. Weight analysis equipment in the maker represents an advance in cigarette quality and weight control technology. It measures the cigarette rod continuously and transmits an electronic signal that activates the tobacco hopper, continuously regulating its feed to the Mark VIII and thereby assuring a uniform rate. Cigarette making has come a long way from the day when an Egyptian gunner rolled tobacco in a paper, lit it and passed it around during the battle with the Turks at Acre in 1832.



THE CIGARETTE Special length is one feature of the Commander (above the rule). Others attributed to the machine on which they are made include uniform diameter, lack of soft spots and firmness from tip to tip.

A Bow for the Hunter

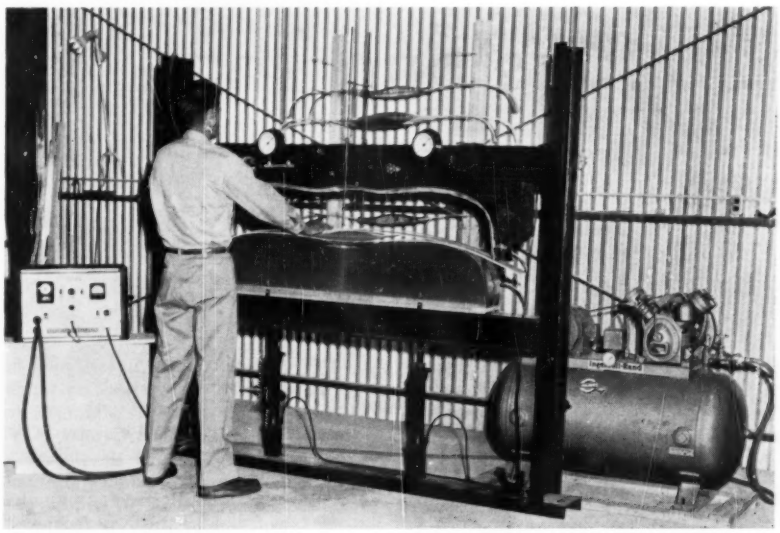
THE HUNTING grounds of upstate New York's Indians are again resounding to the zing of the bow and arrow. Not only in the forests of the tribes of the Six Nations, but throughout the country, there is a growing popularity in archery and bow hunting. It has created demands for a greater quantity of bows, and ones of higher quality than previously available. Standard production methods rely on hand clamps and oven baking—the process taking 8 hours per bow. These had other disadvantages, perhaps the most obvious being stress points created by hand clamps. Bow quality and accuracy were seriously affected.

For the primitive art of bow making, what is equivalent to an industrial revolution has taken place. Wing Archery Supply Company, Houston, Tex., undertook the development of new production equipment and techniques utilizing electronic curing and pneumatic forming and clamping to cut production costs while simultaneously improving quality. It developed a forming press with a stationary upper female mold and a movable bottom mold to hold two bows at once. The mold merely clamps the glass and wood laminations prior to application of high pressure during the curing cycle. Bow parts are not permanently formed by opening and closing the mold.

Preglued 6-foot maple bow strips are placed on the master form along with fiberglass laminate strips. Two air jacks, powered by a 2-stage air-cooled Ingersoll-Rand compressor, raise the die. This forms the laminations to the desired reflex-deflex full working recurve, but does not press the laminations together tight enough for curing. Loading and clamping requires about 1 minute—a much faster rate of speed than was possible with previously used hydraulic jacks. Pressure application by hand clamps took approximately 22 minutes, and the pressure was very uneven.

A total curing pressure of 26,000 to 27,000 pounds is applied across the bows through flexible pressure pads mounted in the stationary female form. The compressor supplies air to these pads at 100 psig. No uneven clamping, as was encountered with hand-processing techniques, is produced. Glue curing and drying is accomplished electronically while the bow is held under pressure. Total production time for two bows is less than a half hour.

Air from the same compressor is used to spray an epoxy resin finish on the completed bows. The air-operated press, coupled with the electronic curing, produces 32 bows per 8-hour shift. The completed product is a bow that is vastly superior to its crude Indian-made ancestors.



BOWS BY THE DOZENS This new air-operated press increases the production and quality of glass-wood laminated archery bows. It is powered by a 2-stage Type 30 Ingersoll-Rand compressor delivering 100-psig-pressure air to jacks for rapid raising and lowering of the mold and to pressure pads used during the curing cycle. The completed bow is vastly superior to its crude predecessor.

Moles Honor Brown and Immerman

HARRY T. IMMERMAN

HERMAN BROWN

HARRY T. Immerman, Larchmont, N. Y., and Herman Brown, Houston, Tex., have been named the 1961 recipients of the awards given annually by The Moles for "outstanding achievement in construction."

Members of The Moles are leading figures in the tunneling, dam-building and heavy-construction industries. Formal presentation of the honors will take place in New York City, January 25. Immerman and Brown make up the 21st pair of awardees in a series that started in 1941. Considered to be the highest honor that can be accorded for service to the American construction industry, the awards are made to one member of the group and to one nonmember. Last year the honorees were William Denny and George M. Drake.

Harry T. Immerman, this year's member honoree, is a native of New York City and is vice president and chief engineer of Spencer, White & Prentis, Inc. He has been with that firm since 1923. Previously he was chief engineer for the building of Lewisohn Stadium, City College of New York. He also designed and supervised installation of the first all-steel subway decking system in New York City in the Times Square area. He has been called upon several times by the City of New York for expert advice on foundation, underpinning and shoring problems, and has served as consultant to industrial organizations, has written numerous technical articles, and lectured in many engineering schools on these subjects.

Herman Brown is a native of Belton, Tex., and is president of Brown & Root, Inc., a Houston enterprise that has grown out of a company he founded in 1914 shortly after his graduation from the University of Texas. The company has been responsible for a total of more than $2150 million worth of construction projects throughout the world. Mr. Brown has organized associate companies in the fields of engineering, marine operations, securities, railway equipment and gravel so that the parent company can have, as he describes it, "unified responsibility for engineering, design and construction." Brown & Root, Inc., clients are principally oil, chemical and industrial concerns, and he himself is an officer or director, or both, of companies in banking, oil, steel, pipelines, equipment, transport, mining, gravel and marine operations.

This and That

Oxygen For Steel Mills

Dravo Corporation, Pittsburgh, Pa., presented a new concept in oxygen-producing facilities for steel mills at the Association of Iron & Steel Engineers' exposition in Cleveland, Ohio. The approach is to make full use of blast furnace gas and standby or excess turbo blower capacity, in conjunction with a Dravo-Linde AG (Munich, Germany) low-pressure tonnage oxygen plant. Blast furnace gas is used to generate steam, which in turn drives the turbo blower, and the excess or spare turbo blower capacity minimizes the compressor requirement for oxygen production. Another feature of the concept is the plan to locate the oxygen unit immediately adjacent to the turbo blowers. Dravo engineers point out that it is desirable to tailor the size, purity, and space requirements of the oxygen unit to fit the physical facilities and the energy balance of each specific steel mill. The steel mill oxygen unit is treated the same as the compressed air, water, steam and electric utilities.

★ ★ ★

Slow Motion Implosion

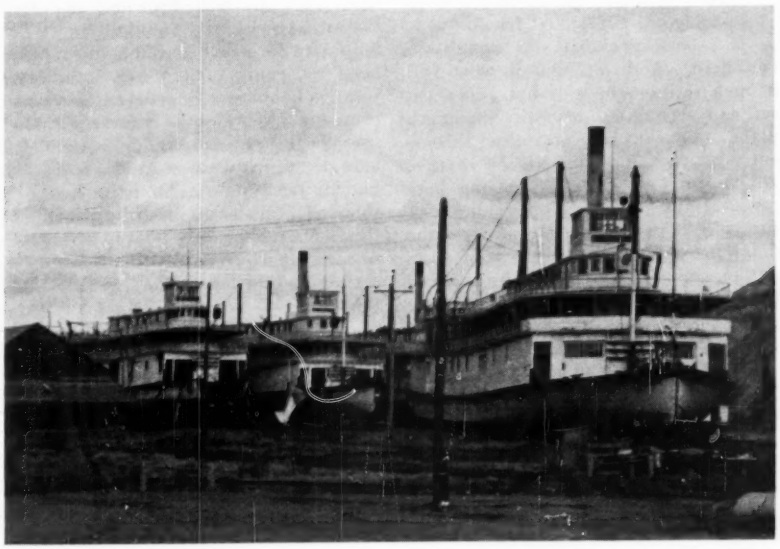
Space enthusiasts would be taken aback to watch a team of engineers in Westchester County, N. Y. They have developed a machine that duplicates conditions, not in outer space, but deep within the earth's crust—temperatures of 5000° F and pressures of 1.5 million psi. The new ultra-high pressure press, announced by F. H. McGraw & Company, makes possible conditions that may be applied to large configurations of metallic and nonmetallic materials—in theory, slow-motion implosion. The unique thing about this press is that it is the first developed with cavities large enough to be useful for commercial manufacturing applications.

★ ★ ★

New Role For Gas Lights

Our June 1960 issue told of some unique uses for gas lights—from lighting used car lots to airport runways. One of the major contributors to the revival of gas lighting has been Arkansas-Louisiana Gas Company. J. E. Waugh, superintendent of the company's Buckley, La., station, has come up with another use for these reminders of the past. Gas lights were installed in an auxiliary station building. Thus should the electric power fail at night, the gas lamps would give enough illumination for work. Inexpensive but dependable, this source of illumination could well be adapted by other companies.

LAST TRIP FOR YUKON STERN-WHEELER



As summer ended, so did the travels of "Keno," one of four surviving Yukon stern-wheelers, pictured in the center here. The 613-ton steamboat retired from service about 6 years ago when riverboats were withdrawn from carrying passengers and freight between Whitehorse and Dawson. The "Keno" was refitted for her final 2-day voyage down the 425-mile length of Lewes and Yukon rivers. The grand lady was beached on a river-lot where she will be preserved as a relic of river navigation in the Yukon Territory, and is destined to become a museum. Built in 1922 and rebuilt in 1937, she is 160 feet long and has a 30-foot beam. Her sister ships, "Klondike," "Casca" and "Whitehorse" will also become a part of Canada's historical preservation.

Shark Attack Census

"May 7, 1959—San Francisco, Calif.—Albert Kogler, 18—bathing 50 yards from shore at 5:30 p.m. with companion, was treading water when a shark, probably a Great White Shark, about 10 feet long, attacked. Kogler's left shoulder was ripped and he suffered deep, jagged lacerations to his back, abdomen and arms. He died $2^1/_2$ hours after being rescued." So reads an entry in a report made by the Smithsonian Institution. It is part of the first worldwide census of shark attacks which shows 36 unprovoked attacks on swimmers during 1959, including 13 which resulted in death. The census was prepared by the Shark Research Panel of the American Institute of Biological Sciences, chairman of which is Dr. Perry W. Gilbert, Cornell University zoologist. The panel, supported by the Office of Naval Research and the Smithsonian Institution, is a clearing house for scientific information related to elasmobranch biology and shark hazards. In addition to the census report, it maintains a complete file of all attacks, containing 700 reported ones dating from 1580. It also sponsors research into environmental conditions under which sharks attack, what triggers an attack, and how sharks are guided to their victims. It is trying to find new chemical and physical repellents that will work even when sharks are in a "feeding frenzy."

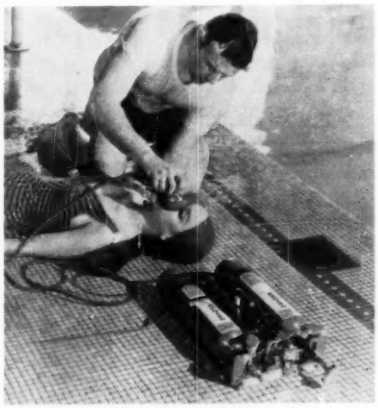
The census indicates that most attacks happen between 40° N and 40° S latitudes, occurring at any time, but especially prevelant when water temperatures are above 68° F. Prime shark territory along the U. S. coast includes the Gulf Coast, the East Coast to New York, and the Coast of California. Australia, South Africa, the Philippines and Japan are also frequent attack areas.

In reporting to skin and scuba divers, Dr. Gilbert pointed out that of the 300 living species of sharks, the Great White Shark (Carcharodon carcharias), commonly referred to as the "man eater," is only one of about 30 which are known to be dangerous to man. He continued ". . .although swimmers should recognize the importance of maintaining healthy respect for sharks (and he gives basic precautions) the likelihood of swimmers being attacked, even in the tropics or semitropics, is less than the probability of their being struck by lightning."

★ ★ ★

Oxygen 200 Feet Away

A smaller resuscitator, claimed to be highly resistant to heat and shock and operable in any position, has been developed for rescue work in such difficult locations as shafts, tunnels, vats, narrow passageways or stairs. The operating head and face mask can be carried or lowered at the end of a hose to a trapped person and can function efficiently at distances to 200 feet from the oxygen supply. Two breathing mechanisms can be operated simultaneously. Named First-In to signify its purpose as the first equipment to be rushed to a victim, the unit weighs only 18 pounds and is no larger than an overnight bag. Its entire mechanism can be quickly removed from an aluminum case and carried by its handle to the scene of an accident or fire. The National Cylinder Gas Division of Chemetron Corporation, which developed the device, declares that it operates in three ways: as a resuscitator, automatically inhaling and exhaling for a victim; as an inhalator, steadily supplying oxygen; and as an aspirator, providing suction to remove obstructing material from the throat. It provides on-the-spot resuscitation and will operate on-the-go, supplying oxygen as the device is carried alongside a stretcher.



★ ★ ★

Vacuum For Upstate

General Vacuum Corporation, East Boston, Mass., announced the award of a contract by Research Laboratories of General Electric Company, Schenectady, N. Y., for the design and construction of a large-scale vacuum facility. The furnace, which will be one of the largest ever built, will be used for high-temperature processing of space-age materials under controlled ultrapure vacuum conditions. It will utilize a high-frequency motor-generator, and the susceptor assembly will provide temperature above 4500° F in a zone that is about 1 foot in diameter and 2 feet high. The versatile vacuum system will operate in the area of 1×10^{-6} mm Hg, equivalent to an altitude in excess of 100 miles above the earth's surface. The equipment will enable the Research Laboratories to accomplish metallurgical operations with tungsten, tantalum and other high-temperature materials on a production scale.

Attitudes For Re-Entry

No thinking space vehicle designer wants his invention to be destroyed by heat and friction as it re-enters the earth's atmosphere. And yet, that is what will happen if the vehicle is not aimed exactly in accordance with the designer's plans. A means for controlling this re-entry attitude, or angle, is by relative air pressure on the sides of the nose cone. If the craft is tipped, the pressure will be greater on one side and the difference will register on heated wires set in an air passage. These metal threads actuate compressed air jets to change direction of the vehicle until the pressure is equalized—that is, according to Yusuf A. Yoler, who obtained a patent for General Electric Company, Philadelphia, Pa., on the device.

★ ★ ★

Lumbering Under The Water

The January 1957 issue of *Compressed Air Magazine* told about the R. M. Pooler Underwater Salvage Company that was recovering logs that were felled 100 years ago and that have since been submerged. This unusual timbering enterprise was in Maine. A new wrinkle has been reported, this time from Rockcroft, Ont. Harry Eames, a business machine serviceman, and Gordon Browne, an electrician, have a hobby of skindiving. To help pay for their pastime, they have been retrieving sunken logs from Mississauga Lake for a Peterborough lumber company. Working as a team, they locate the logs in the muddy bottom, secure them with screws and rope, and budge them loose. To help free the timber, they attach plastic air bags to the ropes. These are inflated with compressed air which forces the bags to the surface and the logs are dragged up with them.

★ ★ ★

Heat-Transfer Design Data

Convection, the motion that results in a fluid due to density differences and the action of specific gravity, is one form of heat transmission in both liquids and gases. It depends, generally, on the fact that a rise in the temperature of a fluid or gas results in a decrease in density. A current is started moving upward from the point at which the heat is applied and heat is transferred from one point in a liquid to another by the moving heated portions.

While searching for methods of cooling re-entry vehicles, a Cornell University mechanical engineer and a colleague have discovered that heat transfer by natural convection may be stopped by reducing spin about a verticle axis. In so doing, an additional stabilizing force retards heat transfer by convection. As a result of the find made in connection with an Avco Corporation research program, the National Science Foundation has made a grant of $72,100 so that Professor David Dropkin can continue to direct the research. He is being assisted by Samuel Globe, an Avco physicist.

Conditions inside a space vehicle are simulated by using cylindrical containers of various sizes, some as small as 1.39 inches high and 5.28 inches in diameter. The containers consist of chromium-plated copper plates $^1/_4$-inch thick, top and bottom, and Pyrex glass sides. Experiments are being conducted with mercury, sodium, sodium-potassium, and other experimental liquid metals. It is hoped that an improved understanding of the natural convection process in confined fluids will be gained in addition to further heat-transfer design data. Eventually a formula may be evolved that will enable space scientists to compute beforehand the amount of heat that will be transferred for a given rate of spin.

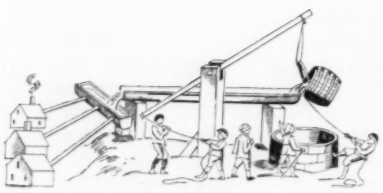
The Story of Pumps

And Their Relation to Major Industries

A glimpse at pumps through the ages, and a closer look at mechanically powered pumps of the last 100 years

G. V. Shaw

THE FIRST mechanical devices for lifting water in Egypt and China were not really pumps, but adaptations of a bucket. The Egyptian



The Swape

shadoof (or *swape*) consisted of a bucket placed at the end of a counter-weighted lever. Another mechanism had pots mounted on a chain running over sheaves; this "pump" is still operated on some remote farms.

The more advanced *noria* was used in both China and Egypt for irrigation. It was a group of buckets formed in the rim of a wheel and increased the volume that could be handled. As a man or animal rotated the wheel, the buckets scooped up water and discharged it into open channels or ditches at the top.

Credit for the reciprocating piston pump is given by some to that venerable Greek scientist, Ctesibius of Alexandria. His device, based on the principle of the syringe, was a crude single-acting unit that was developed to raise water to high elevations or to move it appreciable distances. Natural hydraulic laws were formulated as larger lifting devices were required. Today's pumps are based on these principles.

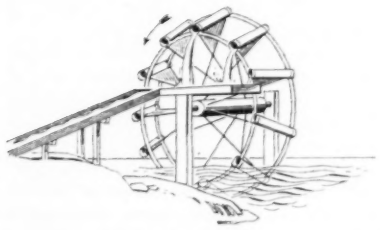
Reciprocators continued to develop. One of their major shortcomings in the sixteenth century was the means of applying driving power. Usually this was accomplished with animals or men. Some paddle wheels could also be found.

By the early seventeenth century, La Hire had devised the doubleacting pump —a decided improvement over the single-acting machines. Water was delivered at both ends of the piston's stroke. Fore-

runner of present double-acting pumps, these units became increasingly popular after the development of the steam engine.

During the opening years of the eighteenth century the Newcomen pumping engine, one of the first applications of steam power to pumps, was developed. A conventional suction pump was reciprocated by a steam-driven piston. After steam from the boiler raised the piston, a jet of cold water entered the cylinder, condensing the steam and creating a vacuum. Atmospheric pressure then forced the piston down.

The first modern reciprocating steam pump probably was a double-acting unit invented by Henry R. Worthington in 1840. The operation was similar to La Hire's. The piston-type pump was successful because it was direct-acting. The driving steam cylinder was built in line with and attached to the water cylinder, working the water piston from the same rod. A mechanism actuated by a linkage



The Noria

from the piston rod threw the valves in the steam cylinder to properly time the piston. This design made possible building small capacity steam pumps. Many thousands have since been applied in innumerable services.

To Adam Scott Cameron, a young Scottish machinist and engineer, having the steam valve thrown by an outside valve gear, seemed unnecessarily complicated. Consequently, Cameron, in 1860, in his small New York City shop, designed one of the earliest efficient pumps. Of the single-cylinder direct-acting crank-and-flywheel type, it was an extremely simple device. It had no external valve gear, the steam slide valve being thrown by the power piston as it came to the end of its stroke. Variations followed and Cameron's shop prospered. His devices gained world-wide reputation and became the nucleus for one of the largest pump production plants.

Centrifugal Pumps

Reciprocating pumps are successful for relatively small capacities and high pressures. However, as the required liquid volumes increased, so did the demand for more economical pumping means.

The first centrifugal pump probably was that of Le Demour. His simple device of 1732 consisted of a straight tube attached at an angle to a vertical shaft. When the shaft rotated, the tube whirled about and centrifugal force raised the water up and out the open end of the tube.

Modern centrifugal pumps depend on the high-velocity rotation of a mass of liquid, contained in a casing, by a shaft and impeller driven by a prime mover. This was not practical until the introduction of the steam turbines of Parsons and Curtis and Tesla's electric induction motor.

A crude unit called the Massachusetts Pump was built in Boston in 1818. It consisted of a casing, rotating shaft and straight-vaned impeller. About 1846, Andrews showed that curved vanes were better than the straight vanes. Great progress has been made since—a development stimulated by improvements in prime movers, especially a-c motors.

Water Handling

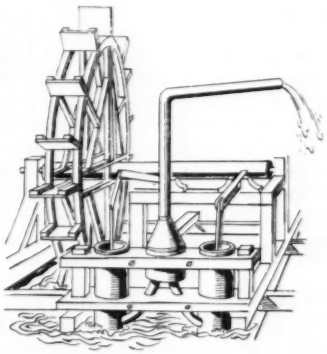
The Egyptians and Chinese, of course, used the water they so laboriously transferred primarily to slake their own thirst or water their crops and herds, or to provide an extremely crude form of sanitation. Today, pumps for domestic water supply and for irrigation and animal husbandry are one important segment of the pump market, to be sure, but it is questionable that they total, either in number or capacity, the pumps used for pushing water to other jobs. It is estimated that some 139 gallons of water per day is used in the United States for every person. Quite obviously not all of this is consumed in the home.

It would take many pages of type even to list the myriad nondomestic uses of water, so we can point out only a few of the most important. One, that has increased tremendously in only the last few years, is for air conditioning. There are literally hundreds of thousands of small and large pumps handling water or water-salt mixtures for space cooling applications. And machine cooling water supplies require circulating pumps in huge numbers. There are even pumps used to circulate coolant through and around other pumps.

The primary metals industries use water pumps in great quantities. Water is called a raw material of steel and aluminum by many experts in metalworking. Such pump developments as the descaling unit, and designs and materials that can handle large quantities of abrasives in suspension have contributed immeasurably to the art of metal making and forming.

Even before metals are made, pumps are at work. In ore beneficiation plants, water for such simple tasks as washing ores to such complex operations as ion-exchange concentration goes through pumps of all sizes and ratings. And in mines, unwanted water is removed from the workings in the tradition of some of the very earliest of powered pumping equipment. As mines have reached deeper into the earth, their very economic existance has often depended on efficient low-cost pumping methods.

It would be possible, of course, to go on with this discussion for a total number of words far in excess of a book. A better way, perhaps, would be to pick, say, three basic industries and show how the development of pumps has been able to aid in their advance. The three chosen—pulp and paper, petroleum and chemical and electric power—aren't necessarily the biggest or most widespread users of pumps. Such industries as discussed above—mining and milling, primary metals, air conditioning—and many others including food processing, the marine group, textiles and the like,



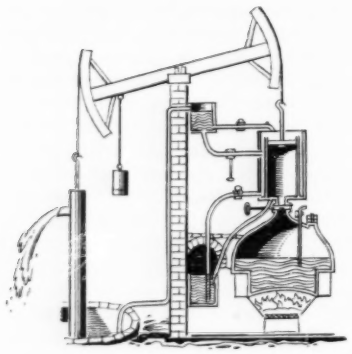
The Machine of Ctesibius

are ignored only because space does not permit a detailed discussion. Certainly all of the major industries of our day use pumps to such an extent that there is considerable justification for the belief held by many that the pump will soon replace the electric motor as the universal machine that will be found without fail wherever one may go.

Pulp and Paper Industry

Paper manufacturing is one of the oldest of all industries. Paper from mulberry bark was made in China during the second century B. C. The Moors in Spain established a hand-dipped paper manufacturing industry about 1150. This method was used until the so-called Fourdrinier continuous process was invented in France by Louis Robert in 1798. Since 1825, when the Fourdrinier was introduced to the U. S., paper of all types and grades has been continuously rolling from the mills. Today, the largest user of paper in this country is the U. S. Government Printing Office which requires about 3060 carloads a year.

Various tonnages are produced in the more than 300 paper manufacturing



The Newcomen Pump

plants across all America. The largest paper machine delivers a continuous sheet of newsprint 25 feet wide at a rate of 3000 feet per minute—about 375 tons every 24 hours. Such a machine requires pumps to deliver not only a veritable river of pulp stock, but to handle wash-water streams, caustics, sizes and the like.

Such a mill also requires some 300 smaller pumps to circulate water and pulp in manufacturing processes. Power to drive the machines and steam for drying must be supplied by steam generators, the heart of which is the boiler-feed pump. In short, it may be said that pumps have made possible the success of the paper industry.

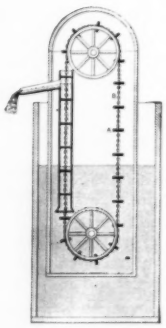
Petroleum and Chemicals

The petroleum industry is one of the largest that depends on pumps for all phases: production, refining, marketing and use of the products. Once reciprocating steam pumps were adequate. Thermal cracking soon introduced higher pressures and temperatures, and the volumes increased so that centrifugal pumps were needed for such various services as charging, reflux and transfer.

Difficulties not previously encountered in centrifugal pump design had to be overcome: compensation for material expansion, alignment with the driver, metallurgy and ease of maintenance. The units were to be called upon to handle gas oil in capacities as great as 1500 gpm, temperatures as high as 750° F and pressures to 1500 psig.

Essentially the success of the high-pressure charge pump that evolved resulted from enclosing the multistage pumping element within a solid, cylindrical, forged-steel barrel or outer casing that supported the unit and compensated for thermal expansion from the great temperature rise.

Thermal cracking methods were largely supplanted in 1939 when Eugene Houdry introduced a catalytic cracking system—a fixed-bed type that required the circulation of sodium nitrate salt (the cooling medium) through a heat exchanger in the catalyst bed of each reactor. In designing the hot (840° F) salt pump, another problem had to be solved before the advantages of the Houdry system could be realized. The Cameron Pump Division of Ingersoll-Rand, in co-operation with Boston's E. B. Badger & Sons which engineered plants for Sun Oil Company and Socony Vacuum Oil Company (now Socony Mobil), studied the severe applications involving corrosion, expansion, lubrication and sealing problems. A vertical submerged unit somewhat resembling the deep well turbine-type pump was devised. Several sizes were evolved, ranging in capacity to 17,000 gpm for heads to approximately 60 feet and requiring 400-hp drivers.



The Chain Pump

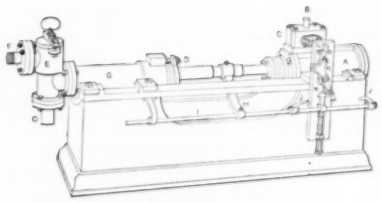
Houdry units were successful on stream until they too yielded to other catalytic processes. However, catalytic cracking had been established, and once again properly designed pumps had made possible important progress in the development of the petroleum industry.

Equally important in a refinery operation is the multi-purpose single-stage process pump. Prior to 1937, more or less conventional water pumps were adapted for moving oil ranging in temperature to 800° F, light hydrocarbon distillates, and liquefied gas with specific gravities as low as or lower than propane. There were numerous weaknesses in the design of these early mechanisms, of which alignment, gasket maintenance and interchangeability of parts are prime examples. In fact, no one manufacturer had a complete line to meet a variety of services calling for capacities to approximately 1500 gpm and pump heads to about 700 feet.

To meet these requirements effectively would necessitate several casing and impeller diameters for the head range in a given size, and several sizes would be needed to satisfy the capacity range. In 1939, the Cameron Division introduced a line of process pumps known as the SFL and MFL. They provided a basic design which has become standard for both American and European pumps.

Chemical production is closely akin to petroleum refining. Pumps perform a vital service, for like a petroleum operation, not only raw materials and finished products must be handled many times, but in-process mixtures must be transferred as well. In the larger plants, hundreds of pumps are required to complete the end product. It is said that chemical plants are currently the country's largest users of pumps for process applications.

Unlike petroleum processers, chemicals producers are not required to circulate materials in such large volumes. Therefore smaller pumps are used in a majority of cases. Also unlike refinery operators, chemicals makers must provide for all sorts of corrosive liquids that require a broad variety of materials for pump construction. While cast iron and stainless steel are used in the greatest number of units, the pump manufacturers must now be prepared with



The First Direct-Acting Pump

Early Steam Power Stations

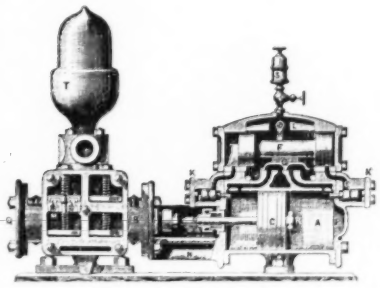
Stations	Date	Driver	Generators	Pumps
Edison New York City	1882	recip. steam	25-cycle 120-kw	recip. steam duplex
59th Street New York City	1902	recip. steam	25-cycle 7500-kw	recip. steam plunger
		vertical* turbine	25-cycle 7500-kw	
Fisk Street Chicago	1903	vertical turbine	5000-kw	turbine- drive centrifugal

* One such turbine supplemented nine reciprocating engines. This station was probably the last major installation to be driven by reciprocators.

designs that can be put together of rubber, lead, ceramics, plastics, glass and many other materials.

Electric Power Industry

The generation of electric current in steam-operated power plants is an industry of comparatively recent origin, and one that has grown tremendously in just 78 years. Included is a chart listing some of the bench marks in central station design and the type of pumps which were used. These early stations did much to fix the design of present day distribution nets and played important roles in the evolution of modern high-pressure steam central plants.



The Cameron Pump

Thus the transition from reciprocating to turbine power was made. The integration of power facilities into a connected system and the pressures resulting from an ever-increasing demand, initiated a new era of design in the 1920's. Higher central station steam pressures led to greater economies and placed great emphasis on the design and reliability of pumping equipment.

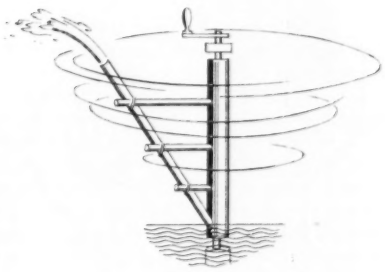
High-Pressure Stations

The initial high-pressure station installation was made at Waukegan (Ill.) Generating Company in 1922. Although the pressure generated by the feed pumps was much higher than previous practice, it is low when compared with present pressures. A new order in high-pressure multistage pump design was established with the introduction of Cameron pumps which carried the now-familiar HMT symbol. The Waukegan pumps, operating at 2500 rpm, developed 500-psig discharge pressure. This installation was followed by others operating in approximately the same steam pressure range.

A notable development in 1925 was the 600,000-kw Richmond Station (Philadelphia Electric Company)—largest of the time. The station load was carried by a multiple of generator units. A 6-unit battery of 6-inch HMT 6-stage, all bronze pumps served the steam generator at a pressure of 525 psig.

These pumps were characterized by a casing of massive construction and bolting to withstand a safe working pressure of 1200 psig. The main casing joint was on the horizontal centerline of the unit for maintenance ease.

The year 1940 marked the beginning of an upsurge in pressures that has resulted in smaller main generator sets per kilowatt produced, but vastly larger boiler feed and condenser circulation pumps. As an example, the No. 5 CHT 7-stage pumps, built that year for Twin Branch Station (Indiana & Michigan Electric Company) were for operating conditions of 1230 gpm at 2800-psig discharge pressure and 340° F. Such conditions dictated a departure



The Le Demour Pump

EDITOR'S NOTE:

This year marks the 100th anniversary of Cameron pumps, one of the most respected names in hydraulics. With the accompanying article, which was written by George V. Shaw, Chief Engineer of Cameron Pump Division of Ingersoll-Rand from 1938 to 1960 when he retired, we present the major milestones Cameron has marked in the design and manufacture of pumping equipment. Pump-engineer Shaw has followed the development of hydraulic equipment since 1902 when he first went to work for The Newburgh Ice Machine & Engine Company. He joined Cameron in 1918. Currently a consulting engineer, he has personally witnessed most of the major advances in pumping technology in the last half century.

1860 A. S. Cameron Steam Pump Works established in New York City. First simplex-type pumps were built.

1868 Cameron moved his shops to the former quarters of the New York City jail. The plant occupied the full city block at the turn of the century.

1909 Cameron became a division of Ingersoll-Rand Company.

1912 A new plant was built in Phillipsburg, N. J., adjoining the 9-year-old Ingersoll-Rand plant. Devoted exclusively to the manufacture of pumps, it provided for necessary expansion and also incorporated the nucleus of what was to become the world's largest and best equipped hydraulic test facility.

1913 The first Cameron centrifugal pump was built. Sixty of these units were installed at the Panama Canal for dewatering service and many still are in use.

1918 The first turboelectric-powered U. S. battleships were equipped with 4-stage centrifugal boiler-feed pumps made by Cameron.

1926 Cameron introduced a line of horizontal process pumps, the first to handle liquids at temperatures to 800° F.

1927 The first Ranch-Pump was made by Cameron. It incorporated the essential integral-shaft pump-and-motor combination of the Motorpump line marketed continuously since 1931. Also, in 1927, the growing pipeline industry was greeted with a variety of centrifugal pumps adapted especially to its conditions by Cameron.

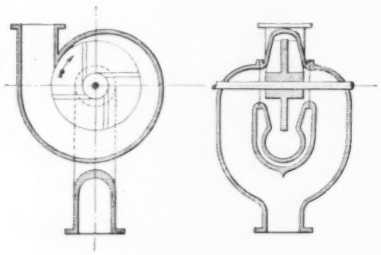
1928 The first successful means of sealing shafts was developed with the introduction of the Ingersoll-Rand Shaft Seal. Originally applied to pipeline pumps, it soon was widely used for a great variety of pumping applications.
This year a line of Cameron hot-oil pumps appeared for pressures to 1500 psig.

1931 The Ranch Pump, with extensive improvements, became the Motorpump; a complete line of the integral-shaft motor-pump units was offered.

1937 The Cameron lines of centrifugal chemical process pumps appeared.

from the horizontally split-case pump that had been successfully applied for lower-pressure service. A "barrel-type" boiler feeder was introduced with the pumping element enclosed in a solid steel casing, or barrel.

The recent past has witnessed the construction of stations with single units larger than many complete stations previously built and the operating steam pressure more than double that of Twin Branch. Two units for American Electric Power Company require feed pumps for a discharge pressure of 4500 psig; another pair for Philadelphia Electric are for 6500 psig.

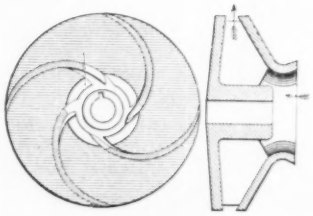


The Massachusetts Pump

To operate one of these gigantic power producers, 2,900,000 pounds of water must be converted to steam every hour, only to be reduced again to water in a surface condenser. Pumps to circulate about 225,000 gpm through the tubes of the condensers—324,000,000 gallons every 24 hours—are needed. After starting, the entire load is dependent on one main boiler feed pump—a 12-inch, 22,000-hp, 7-stage unit with a speed of 3600 rpm. Each of these boiler feed pumps consumes more than three times the amount of power that was generated in each main unit of the Fisk Street Station—the first all-turbine-driven plant constructed in 1903.

Another high mark was established in the 325,000-kw units of Eddystone Nos. 1 and 2 (Philadelphia Electric Company), recently put on the line. To feed the steam generator, 6490-psig pressure is required from the pumps. Problems of economical operation and load control had to be solved by both the station and pump designers. Their study resulted in a system of pumps, rather than a single unit, to develop the necessary pressure. Two parallel circuits, each with its heaters and a series arrangement of three pumps, finally evolved. One circuit delivers half of the 2,000,000 pounds of water per hour, or 2900 gpm, at 568° F to feed the monotube boiler. All of the pumps designed for Eddystone are of 10-inch diameter discharge and have five stages for the low-pressure, six for the intermediate- and four for the high-pressure units.

This thumbnail sketch of these stations indicates the great progress in the development of central stations and the pumps so necessary for their operation. What of the future? In the generation of power, the use of atomic energy appears to hold great promise. The development of nuclear power is still in its early youth. The Shippingport (Pa.) Station of Duquesne Light Company went critical on May 26, 1958; the plant at Indian Point, N. Y. for Consolidated Edison is now under construction. These will provide information required for guiding the development of future power plants to supply the needs of the world's expanding population. As science uncovers knowledge in the use of nuclear energy the ingenuity of our designers will probably be challenged many times as it has in the past to meet pumping needs which as yet lie beyond our horizon.



The Andrews Pump

1939 The barrel-type pump was applied to a 3000-psig boiler-feed job by Cameron engineers.
Vertically split process pumps for easy maintenance reached the market.

1941 The first controlled circulation boiler in the United States was equipped with Cameron horizontal boiler-circulation pumps.

1943 The "Inch" pipelines made petroleum industry and world news with Ingersoll-Rand Cameron pumps helping to push through vital oil supplies.

1950 A touch of nostalgia: the last steam-driven reciprocating pump bearing the world-famed Cameron "Acorn" trade-mark was produced. The centrifugal pump had won the last round in the battle for low-cost efficient pump performance.

1952 The industry's first process pumps designed exclusively for mechanical shaft sealing.

1953 Vertical-type boiler-water circulating pumps for high-pressure boilers were introduced by Cameron.

1954 Cameron boiler-feed pumps for America's first atomic submarine, followed by centrifugal pumps for all nuclear ships as well as atomic powered electric central stations.

1955 Ultra-high-consistency stock pump for the pulp and paper industry utilizing an impeller with diverging vanes that is almost impossible to choke.
This same year Cameron boiler-feed pumps scored a pair of firsts. A full-capacity boiler-feed pump serving a 225-kw station was judged so reliable it was installed without a standby unit. A vertical high-pressure boiler-circulating pump was built with an integral electric-motor drive in which the motor windings are immersed in the fluid being pumped, thereby dispensing with all sealing problems.

1956 This year saw Cameron introduce the first supercritical-pressure boiler-feed pumps for pressures to 6500 psig.

1957 The world's largest boiler-feed pump—a 22,000-hp unit driven by a steam turbine—was built. The two units delivered have been for 7200 gpm at 4550 psig.

1958 The boiler-feed pumps for the world's then largest thermal generating units (500,000 kw) were built by Cameron. The Motorpump line welcomed a new member, the Vapor-Flo, with a special impeller for handling bulk station petroleum products.

1959 A high-pressure boiler-feed pump direct-driven from the main generator shaft of a 225,000-kw unit. This year also marked the manufacture by Cameron of the world's largest cargo pumps for sea-going tankers.

1960 Cameron Division of Ingersoll-Rand Company celebrates its 100th Anniversary with a line of several thousand standard sizes and types of pumps. In the last decade alone, for example, maximum ratings of its boiler feed pumps have jumped from 3000 to 6500 psig, from 2800 to 7200 gpm, from 400° to 575° F and from 3000 to 22,000 hp.

EDITORIAL

Inventory

THIS is the month when year-end inventories occupy the minds and time of most business men. It is a time for summing up, for putting the final figures at the bottom of the profit or loss column. This has been a year of intense competition. Even though economic indicators have been good—personal income and gross national product being near record levels—the market place today definitely belongs to the buyer. Quality, performance, delivery and price rule.

Inventories are largely cost control devices. They are a means to an end, rather than a simple listing of what's in stock. With this in mind, we'd like to suggest that an inventory of the compressed air system be taken. It could result in better product quality and performance. It could have something to do with improving customer service and deliveries. And, there's a good chance it might help out from a price standpoint.

What does an inventory of a compressed air system consist of? It's much like any inventory—what goes in must come out. Like the flow through a plant, raw material goes in one end and comes out the other somehow increased in value.

How to inventory the air system presents no great difficulty. The first measurement, of course, is of what is going into it. A recording wattmeter —or a steam flow meter—is connected to the compressor driver. This will indicate the load at which the machines are operating and the amount of time at each step of load. Then, for a suitable period (which should be chosen to coincide with peak loads in the plant), the output of the compressors can be calculated.

It is, of course, possible to put a flowmeter on each air outlet to secure the figures on what is coming out of the system. This is hardly practicable, however, so the next step is to measure losses. The same recording set up is used to measure compressor output when no air is being used but while full pressure is maintained in the system. The difference between the two input figures measures the air actually being used to add value to products. The loss figure, of course, is direct loss and must be charged off in one form or another. If it represents more than 10 percent of the total air use, chances are that it would cost less to completely rehabilitate the pneumatic system than it would to absorb the air losses.

But quantity of air through a system isn't the only thing that must be measured in an inventory. Quality also counts. Is the pressure at pneumatic tools, rock drills or other air-operated equipment, running at full load, at least as great as the manufacturer's recommendation? If not, losses of operators' time and perhaps quality will have to be charged off as nonproductive cost. The quality of air is also affected by the amount of water present in it. If inadequate aftercooling is letting large amounts of moisture condense in lines and pass through the tools, or rock drills, or form rust and scale that will also find its way there, then the increase in equipment maintenance and the decrease in its service life must be considered losses, too.

There are many reasons why an air system can get in such a condition that 10 percent or more of the input is direct loss—a situation as intolerable as a scrappage rate of 10 percent on a product line. Quite a bit of the fault must be placed on the great expansion of capacity called for during and since the war years. Systems were added to, often without regard for their capacity to carry the increased loads. The only result was a gradual, almost unnoticeable, reduction in pressure. Production may have held up, but this was probably due to increased tool and drill design efficiency. This leads to the fact that all the benefits built into new models, such as greater power and higher speed for the same or lighter weight, cannot be realized with a less-than-adequate air system. Losses in efficiency such as this cannot be entered on the ledger in other than red ink.

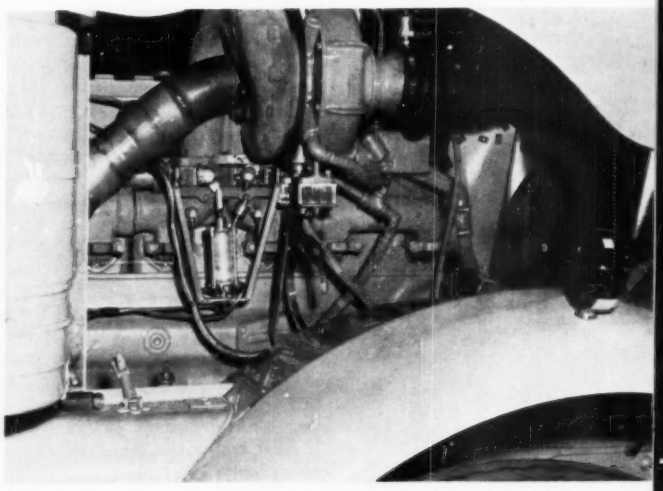
It should be emphasized that it is no more difficult—and possibly less expensive—to adequately maintain an air system than it is to service any other type of power distribution net. The reason that air systems are neglected is because of their inherent safety and overload-absorbing qualities. With electricity, fuses will blow if wires are overloaded. Overheated lines and short circuits cause fires, so we tend to pay most attention to them. Hydraulic lines that leak, spray oil on men, floors and machinery and are immediately fixed. Air lines, on the other hand, have no fuses that pop when overloads are applied. Leaks from pneumatic lines are not immediate sources of damage or danger to their surroundings, and thus all too often are ignored.

The payoff from an air system inventory can be appreciable. Production rates of pneumatic tools and rock drills can be boosted as much as 40 percent in the worst of cases and by 10 percent in all but the most modern, well-maintained systems. Their service life can be extended and maintenance costs reduced by supplying them with a high-quality air stream. Old compressors can be given an extension of life if they are relieved from compressing air that is needlessly blown back to atmosphere through leaks. New compressors required for expansion programs can be smaller, and will last longer with less maintenance. Power costs can be cut.

Basic criteria of adequate air systems have been published in this magazine from time to time and are available in reprint form. Specific questions on air system problems can be answered either with article reprints or by referring them to qualified engineering specialists in the field. We believe that thorough air inventories are as important to modern day cost reduction as any of the other recognized inventory and control efforts.

Wrought Stainless Yields to Cast Alloy Steel in Valve Flapper and Manifold to Assure Reliability of—

AUTOMOTIVE COMPRESSION BRAKE



WILLIAMS COMPRESSION BRAKE INSTALLED ON TRUCK

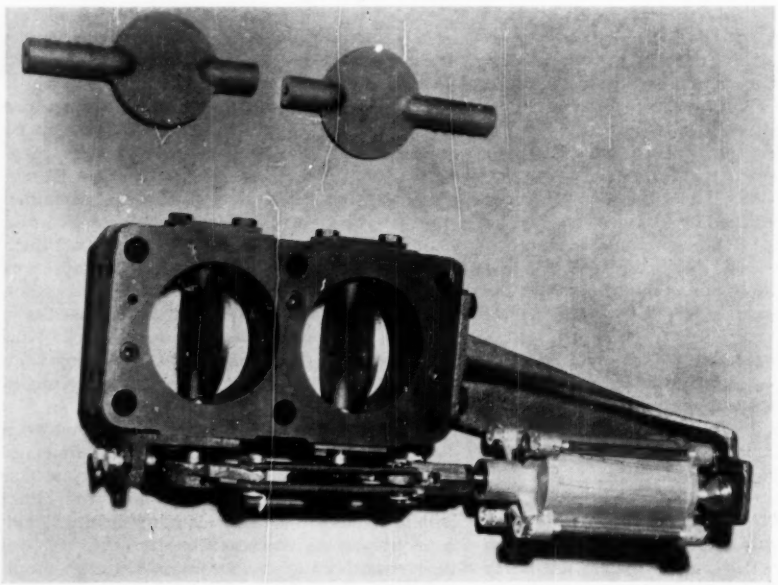
DESIGNED as an auxiliary braking system for diesel and gasoline truck engines, the Williams Compression Brake illustrated at the top of this page operates independently of air or mechanical brakes. It provides safety and reduces operation and maintenance costs. Developed by Power Brake Equipment Company, Portland, Ore., the device utilizes a braking action and butterfly valve controlled by air or a mechanical override and lever. When a truck equipped with the system descends a grade, the butterfly valve automatically closes to begin pressure build-up when the foot throttle is released.

Bolted directly to the manifold or welded compactly into the exhaust pipe between the manifold and muffler, the brake restricts the exhaust and builds up a back pressure of 40 to 50 psig in the exhaust manifold. By thus converting each cylinder into a low-pressure air compressor, the braking device introduces a retarding force against piston head areas that is at least equal to the engine's horsepower output.

How It's Made

The heart of the Williams brake mechanism, for the model shown below, is an intricately shaped twin-butterfly valve, cast in type HH heat-resistant steel alloy (Alloy Casting Institute designation). When the unit was first devised, each flapper was fabricated from a 3-piece wrought stainless steel assembly. It involved several machining operations, plus welding and stress relieving. The center disk was turned from plate stock, set up at an angle to produce the slight peripheral bevel required. Two machined stub shafts were then welded to either side of the disk, using a special fixture to assure proper alignment.

Now the disk, with its bevel, and shafts are produced as one integral piece. Except for turning the stub shafts to fit housing bearings, all machining, welding and stress relieving operations are eliminated. This was accomplished with the required accuracy and high part-to-part dimensional uniformity by use of the shell molding technique. Needless to say, this change in manufacturing processes has resulted in a reduction of fabrication costs.



BUTTERFLY VALVE FLAPPERS INTEGRALLY CAST

Heat distortion of the valves was eliminated at the same time, for the type HH alloy casting that replaced the wrought stainless assembly is especially formulated for temperatures above 1200° F. It is 25-percent chromium, 12-percent nickel heat-resistant grade; therefore, hot exhaust gases experienced in operation do not cause warp. Coupled with this strength is the excellent corrosion resistance of the HH alloy to the hot exhaust gases.

Pressure retention for brake reliability was assured by substituting the cast heat-resistant alloy, which offers high strength (33,000 psi at 1400° F) and maintains dimensional stability when exposed to temperatures and applied stresses. A prime reason for the high temperature strength of cast heat-resistant alloys is their high carbon content (0.20-0.50 for type HH). This advantage cannot be extended to wrought stainless grades since deliberately increasing high temperature strength by adding carbon would make rolling and forging operations difficult.

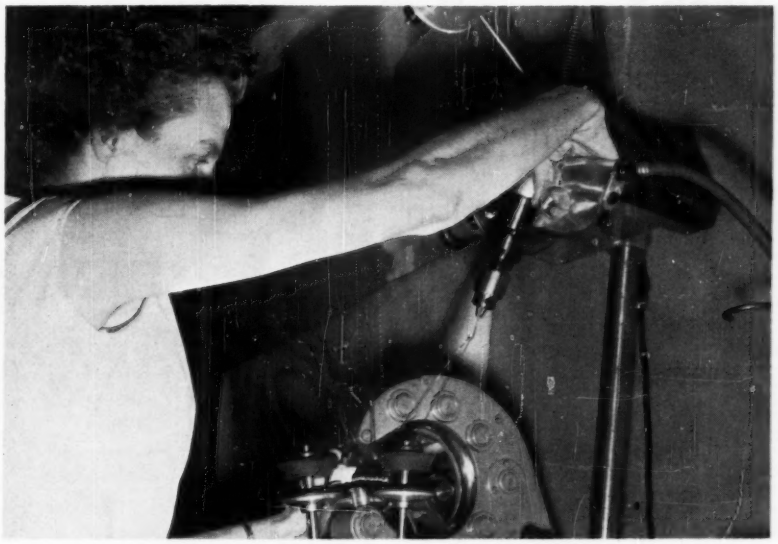
Twisting Transformer Leads

A SAVING WITH AIR POWER APPLICATION

GONE are high-button shoes but for a West Coast electronic components manufacturer at least, the buttonhook is still very much alive. Combined with an air-powered drill, the accessory to yesteryear's footwear has cut a manufacturing cost.

The electronics concern was making small transformers. One of the steps in assembling them was twisting together many pairs of wire leads. For a long time, a buttonhook in the hands of an assembly worker had been used to grasp the wires. Because both hands were needed on the buttonhook it was difficult to twist the wires close to the core of the transformer. The manual turning produced nonuniform twists, and because each unit had many leads, much time went into this step.

The manufacturer sought a faster way to twist the wires and a method that would also be more uniform. He hit upon the idea of placing the trusty buttonhook in the chuck of an air drill. The hook would still grab the wires easily but the drill would wind them down snug in an instant. An Ingersoll-Rand 00A2Q Drill was fitted with the buttonhook. The drill's grip gave the operator a better hold in pulling up the wires and allowed fine control of the direction of twist as the core was approached. Only one hand was needed; the other stayed free to hold the small core and to position the leads.



DRILL AND BUTTONHOOK **Powered by this compressed-air driven drill, a buttonhook twists down pairs of transformer wires, speeding the job by 30 percent.**

The air drill/buttonhook combination worked. A uniform, better looking twist grew as each set of leads was wound and the time to complete a single unit was cut by 30 percent. With the step-up in production, the drill paid for itself in 2 days.

Spraying Epoxy Resins

INTRICATE shapes and rough surfaces can be given a tough, thin film of corrosion protection by using a spray-on method. The system is not only easy to use, but economical as well, and the results give pipe fittings, supports and other hardware the physical and electrical protection of a true epoxy.

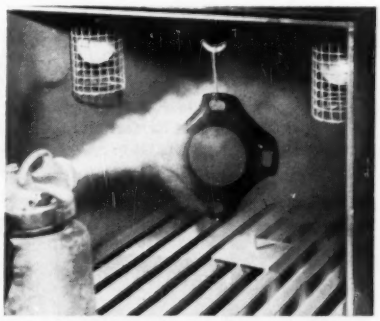
Equipment required is portable and inexpensive: a flocking gun, heating devices, a means of cleaning the parts to be coated, an air source, a spray booth, and preferably a dust collector.

A commercial grade flocking gun with adjustable air and orifice controls should be used for best results. Flow of the finely divided powder can thus be controlled for application to parts of various sizes (the photo at right shows a typical part being sprayed with the epoxy).

The cleaner the surface to be coated, the better the resulting bond. Sand or shot blasting is suitable, as are solvents or pickling. For spraying, a minimum of 40-psig pressure air is suggested.

A dust collector in conjunction with a spray booth will help utilize the full potential of the resin and provide a clean operation. This equipment prevents waste, for unused resin can be reclaimed from the collector. A variety of standard collector models is available.

The resin used is Scotchkote 101, a product of Minnesota Mining & Manufacturing Company. Sprayed on heated parts, it reportedly will flow evenly to give a uniform, smooth coating that cures in less than 60 seconds. When cured, it is completely thermoset and will not flow under pressure or upon heating. It has an adhesion strength of more than 3000 psi, high impact resistance and resists attack by most chemicals, including hydrocarbons such as fuel oil, gasoline, kerosene and sweet or sour crude. A typical resistance value of a 10-mil Scotchkote 101 coating is 10,000 megaohms per square foot.

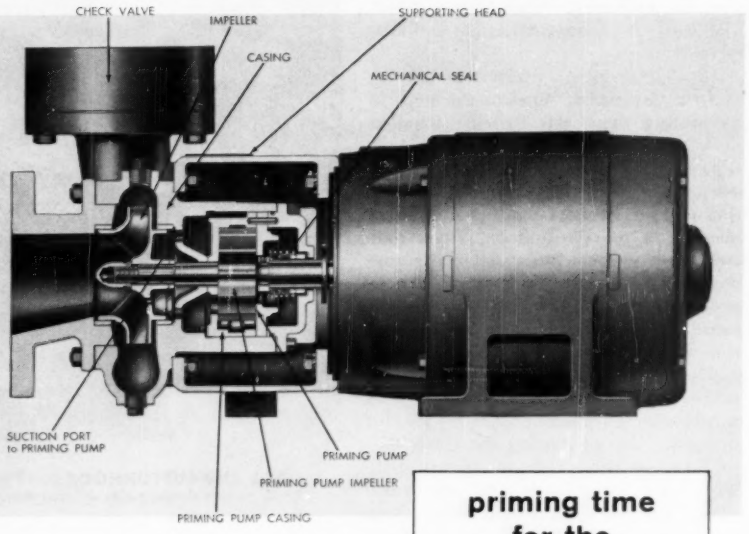


new self-priming pump efficiency

for bulk stations . . .

with Ingersoll-Rand "centri-prime" Motorpumps

unique design incorporates built-in positive displacement-type priming unit



The new Ingersoll-Rand "centri-prime" Motorpump now combines—in one compact unit—positive displacement-type priming with the efficient, high speed liquid handling of a centrifugal pump. This totally different pump is designed specifically to handle suction lifts such as encountered in underground storage tanks, top unloading of tank cars, transports and similar bulk station applications.

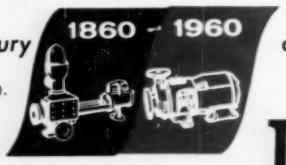
On straight suction the unit will prime under lifts to 19 feet total head. Once liquid reaches the standard impeller, the centrifugal pump takes over.

priming time for the "centri-prime"

(example for 16' lift)
6" pipe: 4.2 sec/ft
5" pipe: 3.0 sec/ft
4" pipe: 2.0 sec/ft
3" pipe: 1.1 sec/ft

Get complete facts on the amazing efficiency of the new "centri-prime" Motorpump. Write today for Form 70215, and see your local Ingersoll-Rand representative or oil equipment jobber.

a century 1860 – 1960 *of pump progress*



New Ingersoll "centri-prime" Motorpump. 5, 7½, 10 and 15 hp sizes for deliveries to 600 gpm, heads to 120 ft.

from the leading manufacturer . . .

Ingersoll-Rand

11 Broadway, New York 4, N. Y.

Other Ingersoll-Rand pumps for bulk plant service

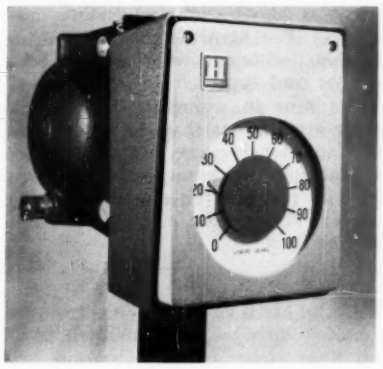
Compact Motorpumps | Horizontally-Split Pumps | Cradle-Mounted Pumps

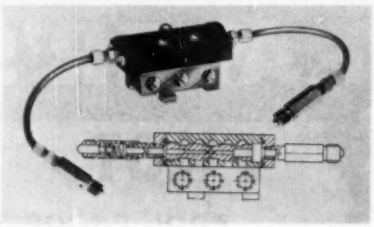
185A9

Industrial Notes

TO INCREASE OUTPUT of screw driving, grinding, nut running, drilling and similar production operations, a program of planned annual retooling is desirable. Plant studies show that portable power tools may be producing only 60 percent of rated output, according to a 28-page report published by Ingersoll-Rand Company. The guidebook offers basic formulas for computing the dividend on payroll dollars possible by this planned annual retooling. As an example, assume a particular operator uses a power tool a daily average of 4 hours, or 50 percent of each 8-hour working day. If his total pay is $5000 a year, labor cost for operating the tool in question is $2500 per year. If the tool is only 50 percent efficient, the annual loss in output is $1250. By replacing this inefficient tool with one operating at peak efficiency, a $1250 annual dividend on payroll dollars can be realized—and this on one operator's wages alone. Subtracting the cost of the new tool gives the net dividend on payroll dollars. The publication also records reasonable and profitable annual retooling rates as confirmed by field experience. Confirmed profitable rates range from 5-percent annual retooling for air hoists to 50-percent rates for chippers, scalers and riveters. Typical figures for tool costs, pay rates, numbers of workmen and other data are provided for the formulas. Work space is given to make your own computations. As a companion to the guidebook is a slide rule computer for rapid calculation of your gross dividend on payroll dollars. These forms, Nos. 5250A and 5290, are indispensible for all air tool users. *Ingersoll-Rand Company*, 11 Broadway, New York 4, N. Y.

A PNEUMATIC transmitting bellows flowmeter described as having unusual temperature stability has been introduced by Brown Instruments for flow or liquid level measurements. Utilizing modular construction, the transmitting units are available in both indicating and nonindicating models featuring a flapper-nozzle pneumatic circuit, a pilot valve with controlled bleed for stability, and a Ni-Span C rebalancing capsule. Because of its zero thermo-elastic coefficient, the rebalancing capsule reduces zero and span shifts to less than 0.5 percent per 50° F ambient change. Modular units, according to the company, simplify operating and maintenance. Each major component of the transmitter can be independently removed by sliding a concentric scale indicator free from the fluorescent-tipped pointer. Span, zero and linearity can be adjusted without disassembly. The transmitter provides 2-way overload protection while the flowmeter itself can take full static pressure overload in either direction. The device is available in models for measuring liquid level in closed tanks under pressure or vacuum and for flow or open tank measurements. *Minneapolis-Honeywell Regulator Company*, Brown Instruments Division, Wayne and Windrim avenues, Philadelphia 44, Pa.





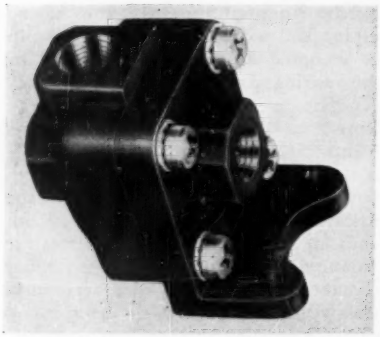
THIS IS A 4-way, 1/4-inch, 5-ported pilot-operated air valve. Developed for a wide variety of bleeder operations, its mechanical simplicity makes it completely reliable and ideal for sequencing, remote control and other automatic applications. Since there is no fragile electrical circuitry in the valve, there are no hazards due to moisture or explosive atmospheres. It is capable of more than 1000 cycles per minute and is reported to have a life expectancy exceeding 50,000,000 cycles. Small bleeder operators that feature a hardened ball-nose plunger can be mounted anywhere, thus saving piping and wiring costs. Operators can be mounted so they will be tripped by the moving parts of machinery. They can also be used as a 2-way normally closed valve in other circuit requirements. The valve's operating principle is simple: line pressure is admitted to both ends of the spool through the drilled out core. Since the areas at both ends are equal, the resultant thrusts are balanced. Bleeding the air from either chamber, by a soft momentary touch, upsets the balance causing the spool to shift toward the bled, or lower-pressure, end. The valve will operate at less than 5-psig pressure. It is available as a double-header (as illustrated) for momentary operation or a single-bleeder for maintained operation. *Alkon Products Corporation*, 200 Central Avenue, Hawthorne, N. J.

STEEL TUBING can easily be selected according to type, finish, analysis, formability, machinability, weldability and relative cost with a chart published by Joseph T. Ryerson & Son, Inc. Characteristics of seamless and welded round, square and rectangular tubing for mechanical, hydraulic cylinder, fluid line, and structural applications are listed. Elements such as size ranges, wall thicknesses and stock lengths, along with the ability of the tubing to develop added strength and hardness through heat-treatment, are also included. Tips on when to use tubing instead of bar stock complete the data given. The chart, Technical Bulletin 12-10, is available without cost. *Joseph T. Ryerson & Son, Inc.*, Box 8000-A, Chicago 80, Ill.

WARREN temperature regulators are described in a 16-page bulletin (No. 502) recently published. It discusses the design, operation and typical applications of several types of these self-contained units. Capacity charts, as well as tables, are tabulated in terms of gallons of water heated and pounds of steam consumed at different steam pressures for easy valve sizing. *Warren Engineering Company*, Main Street, Broadway, N. J.

AN AIR SHUTTLE valve that selects and directs the flow of air from one or the other of two controlling devices to a common outlet has been developed by Westinghouse Air Brake Company. Ex-

tremely sensitive, only 1-psig pressure differential will seal off the low-pressure line and connect the higher-pressure line to the outlet. This unit contains only one moving part—an easily replaceable rubber diaphragm. It has no springs; nothing can bind or stick, according to a

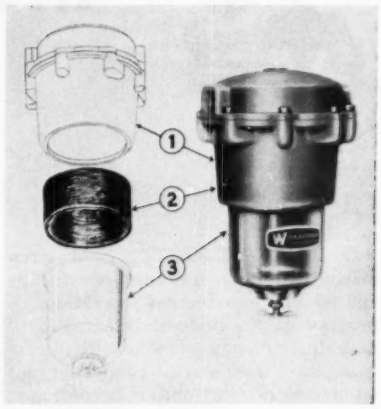


company report. Made of die-cast aluminum and weighing 6 ounces, it can easily be supported by piping alone. Mounting feet are included, however, for installations with vibration or long pipe runs. Available with $^1/_8$- or $^1/_4$-inch NPT ports, the valves are suitable for a maximum air pressure of 200 psig. Maximum operating temperature is —40° to 160° F. Intermittent temperature of 200° F is permissible. *Westinghouse Air Brake Company*, Industrial Products Division, Wilmerding, Pa.

PERLOX is a low-cost, low-density insulating fill that is said to be especially suitable for use with low-temperature liquefied gases. Formed from expanded silica aggregate, it offers the maximum thermal resistance at a minimum cost, according to Johns-Manville, yet is completely safe for the majority of cryogenic applications, including insulating liquid oxygen and liquid hydrogen. Perlox is a completely inorganic material, is both physically and chemically stable, and because of its structure and powder form, provides very little body for moisture pickup. When the material is settled in place, it weighs only 3 pounds per square foot. Temperature limits are from —450° F to 1400° F. At —300° F, it has a thermal conductivity of slightly less than 0.10 Btu inches per square foot per degree Fahrenheit per hour. It is available in loose powder form, packed in paper bags. *Johns-Manville*, 22 E. Fortieth Street, New York 16, N. Y.

FOUR motorized hardness testers of the Kentrall line manufactured by The Torsion Balance Company, are described in Bulletin CRS-60. By removing major test loads automatically, these new units increase reproducibility of test results and raise the productive capacity of the machine. The cost of these motorized testers is the same as hand-operated machines. The Kentralls are available in combination testers, which provide both regular and superficial Rockwell hardness testing in a single machine. For those applications that do not require the additional range, the testers are available as single-purpose instruments for either regular or superficial testing alone. *The Torsion Balance Company*, Clifton, N. J.

PURE-FLO is an air filter that concentrates on three major features desired by air filter users: efficient filtration, low pressure drop and large bowl capacity. As illustrated, an extra casting has been incorporated between the cover and the bowl of the filter. This houses the filter cartridge and makes it possible to use a larger cartridge than those in previous designs. The filtering area of the cartridge in the $^1/_2$-inch pipe-thread size, for instance, is 17.5 square inches. Because the air has this increased surface through which to travel, less pressure drop results. The additional casting for the cartridge housing serves another purpose. The cartridge has been entirely removed from the filter bowl, whereas with all comparable filters, 75 percent of the bowl storage area is taken up by the filter cartridge itself. The bowl will hold $^1/_2$ pint of contaminants before draining is necessary. The filter car-



tridge is made of an impregnated felt material that is rigid. It will filter out particles as small as 5 microns and can be cleaned in a solvent and re-used indefinitely, according to company reports. *Wilkerson Corporation*, 1645 W. Girard Avenue, Englewood, Colo.

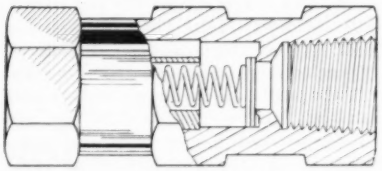
HORIZONS, INC., a process and materials research organization, has announced the addition of a palladium-filter hydrogen extraction system to its gas analysis facilities. The new process, quicker and more accurate for hydrogen measurement than vacuum fusion determinations, involves pushing gases released from a heated metal sample against a palladium element, which allows only the hydrogen to filter through. Amounts of residual hydrogen in steel, titanium and tungsten are critically important to metalworking industries because excessive gas content causes brittleness in metallic grain structures. Analysis can be accomplished in half the time required by previous methods, it has been reported. Further, the palladium filter method guarantees measurement accuracies within 10 percent of the

NEW CONRADER'S FILTER TYPE
UNLOADER PILOT VALVES
24 HR. SERVICE
Rebuilt unloader valves. All makes and sizes. New valve guarantee.

FOOL PROOF
Simpler in design
Fewer moving parts
TAMPER-PROOF
All working parts are concealed
HOW'S YOUR STOCK OF SPARE VALVES?
R. CONRADER CO. INC.
SINCE 1925 BOX 924 • ERIE, PA.

amount of gas present in the 25 parts-per-million range or less. In volumes greater than the 25 parts-per-million range, the measurement is accurate within 5 percent of the amount of gas present. The system can measure hydrogen quantities as low as one part per million. Analysis service for all gases is available to industry at large, and additional information may be obtained by writing to the research organization. *Horizons, Inc.*, 2905 E. Seventy-Ninth Street, Cleveland 4, Ohio.

FROM Mount Vernon, N. Y., comes this disk-type, check valve with its 1-piece body. Its calculated bursting pressure is 20,000 psig. Having no moving parts except the small disk, the valve is reportedly unaffected by foreign matter. The opening pressure is 2 to 8 psig, and the soft surface of the disk provides com-



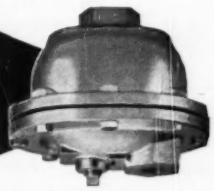
plete sealing at all pressures in air, oil and water. Known as the 900 series, units are available in brass in $1/4$-, $3/8$-, and $1/2$-inch female pipe sizes, with other sizes and materials to order. *Bodnar & McDermott Manufacturing Company*, 19 Beechwood Avenue, Mount Vernon, N. Y.

CONTROL of gas or liquid at a temperature range of −320° to 1500° F and at pressures to more than 3500 psig requires specialized components. More than 2500 of them are described in an AiResearch catalog. Major items available for aircraft, missile or process industry applications include fuel control systems, pneumatic and electric valves, actuators, and thermostats. In its easy-reference format, products have been divided into fourteen families. Each is preceded by a brief introduction. Within catalog sections representative off-the-shelf components are listed. For each of 300 typical control components, complete sizing information, specifications, photographs, 3-view drawings and application performance curves are given. *The Garrett Corporation*, AiResearch Manufacturing Company, 402 S. Thirty-Sixth Street, Phoenix, Ariz.

DESIGN features and performance advantages of R/M CX Molded V-belts recently introduced are detailed in a new bulletin (No. M220). A fully molded, fully jacketed notched V-belt, the R/M development is reported to be the only belt of its kind for light-duty transmission drives. To date, it is available only to original equipment manufacturers. Included in the descriptive literature are specifications for standard and non-standard belt sizes and a condensed pre-engineered CX V-belt drive selection table for easy reference in determining the correct belt size for electric motor drives. Performance tests have proved the new belt to outlast conventional types by as much as eight to one for a variety of applications, according to company spokesmen. *Raybestos-Manhattan, Inc.*, Manhattan Rubber Division, Passaic, N. J.

FOAMAT is a new AAF air filter utilizing a single sheet of synthetic plastic material. Sponge-like in appearance, Foamat breaks an air stream into little jets as it passes through the filter. Dust and dirt cannot follow and are trapped in great quantities by the cells. Designed as a permanent filter, it will not pack, settle, separate or develop thin spots. Reportedly, it eliminates all media replacement and offers greatly reduced maintenance. It is said to be the only filter on the market today that can be practically and successfully washed with a standard spray-head hose nozzle

THE "NO-TROUBLE" AIR TRAP



THE ARMSTRONG NO. 21 BALL FLOAT AIR TRAP — GUARANTEED TO SATISFY OR YOUR MONEY BACK

For draining moisture from air lines, (drip pockets, small separators, small receivers, etc.) you can depend on the Armstrong No. 21 air trap for trouble-free service. It's built to the highest standards—guaranteed to satisfy. Can be used wherever no heavy oil or dirt is present. Check the features:

- No Air Loss—valve is always water-sealed.
- Stainless Steel Parts—float, leverage system and valve seat. Valve is heat-treated chrome steel.
- Small, Compact—Simple design, with a strong, cast semi-steel body.
- Self-Priming—no need to add water to start operation.

Bulletin Describes Complete Line of Armstrong Air Traps

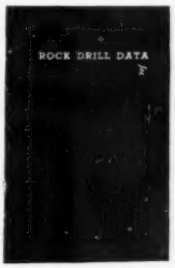
Bulletin No. 2024 shows how to select air traps for any job. Gives dimensions, capacities and prices of all Armstrong air traps. For your copy, call your local Armstrong Representative, or write:

8856 Maple St., Three Rivers, Michigan

ARMSTRONG MACHINE WORKS

ROCK DRILL DATA

Concise • Complete • Invaluable



Designed for almost everyone who is connected with rock drilling.

Contains immense amount of extremely useful information, tables and illustrations.

It is pocket-size, durably bound—an ideal reference book for the rock drill man.

Price - $3.00 per copy

COMPRESSED AIR MAGAZINE CO.

942 Memorial Parkway

Phillipsburg, N. J.

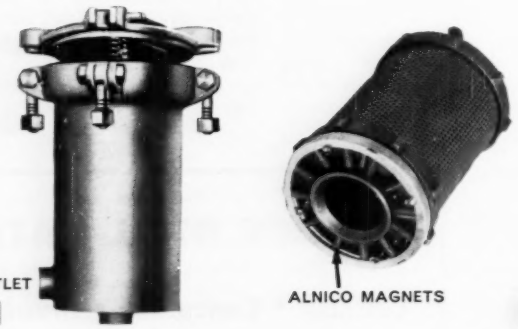
without removing the filter from the filter bank. (Where stubborn process dusts are encountered, the filters may be removed, soaked in a mild detergent, rinsed with cold water and reset in place.) The media is pleated into a holding frame to present the greatest possible area for dirt storage. It is completely interchangeable with other pleated-media filters. Foamat is resistant to all moisture and vermin and is chemically treated for permanent flame resistance. Available in three models that permit capacities as high as 1800 cfm per cell, the filter is designed to handle velocities to 450 feet per minute. Noncorrosive aluminum cells are standard. Product Bulletin No. 208 describes the construction, operating characteristics and engineering and performance data. *American Air Filter Company, Inc.*, 215 Central Avenue, Louisville 8, Ky.

SCREW THREAD technology is given in a basic guide that is useful to equipment specifiers, engineers and machine designers. *Harper Thread Guide*, as the 16-page illustrated booklet is called, offers a basic introduction to the varied types of threads. It briefly outlines the history of threads, defines the terminology of the trade, and explains with diagrams the differences between the major kinds of screw threads. Several pages of charts detail the measurements, characteristics, and capabilities of the standard thread types according to the Unified and American Thread Series, ASA B 1.1-1960. Additional charts describe the characteristics and other data of tapping screws and wood screws. A torque guide outlines the normal load values that may be applied to bolts of various metals. Copies are available without charge. *The H. M. Harper Company*, 8200 LeHigh Avenue, Morton Grove, Ill.

SKINDIVERS will be happy to hear that a new and lower priced steel cylinder for air used by manufacturers of skin diving equipment has been introduced by Walter Kidde & Company, Inc. These new cylinders feature milled threads for longer service life and tighter valve fit than usual. They are available with $^1/_2$-inch tapered pipe threads or $^3/_4$-inch straight threads for O-ring seals. All the units have epoxy coatings that salt tests have proved to stand up two to three times longer than customary finishes. As for the volume of these cylinders, each is 71.2 cubic inches. *Walter Kidde & Company, Inc.*, 675 Mail Street, Belleville 9, N. J.

FOR low-horsepower jobs, a compact NEMA Size 00 starter has been developed by Square D Company. Rated from $^3/_4$ hp, 110 v to 2 hp, 440/550 v, the device costs less than the Size 0 starters which previously were specified for these applications. Featuring easy inspection and maintenance, the Size 00 has straight-through wiring, pressure wire terminals, molded coil and 1-piece melting alloy overload relays for complete motor protection. It is available in either open or a NEMA Type 1 en-

GET THE *ADDED PROTECTION* OF MAGNETIC SEPARATION WITH THIS BASKET-TYPE STRAINER



Nugent now manufactures a line of basket-type strainers offering the added protection of magnetic separation. Specially designed Alnico magnets establish a magnetic field through which the strained liquid must pass as a final stage before leaving the unit. Thus, minute ferrous particles are trapped and removed from the fluid stream.

If you have valuable engines or other equipment which demands top-notch lubrication protection, it will pay you to get the full story on the Nugent combination strainer-magnetic separator.

Write today . . . no obligation, of course.

ESTABLISHED 1897

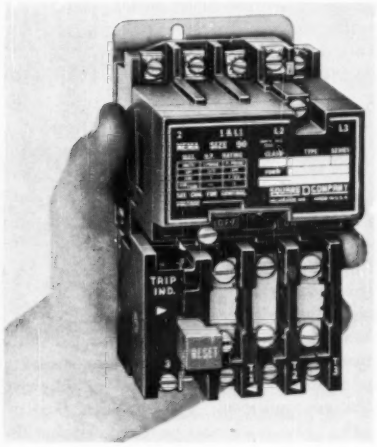
REPRESENTATIVES IN PRINCIPAL CITIES

WM. W. NUGENT & CO., INC.
3434 CLEVELAND STREET, SKOKIE, ILLINOIS

OIL FILTERS • STRAINERS • TELESCOPIC OILERS
OILING AND FILTERING SYSTEMS • OILING DEVICES
SIGHT FEED VALVES • FLOW INDICATORS

"E = MC²?"

closure with an optional pushbutton or selector switch in the cover. It may also be obtained without overload relays.

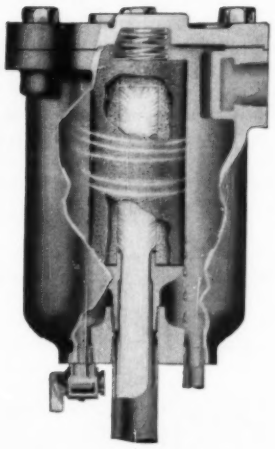


Details are given in Bulletin SM-297. *Square D Company*, Department SA, 4041 N. Richards Street, Milwaukee 12, Wis.

BOOKS . . .

Design of Small Dams (published by the Bureau of Reclamation and available from Superintendent of Documents, United States Government Printing Office, Washington 25, D. C., or Bureau of Reclamation, Denver Federal Center, Denver, Colo., Attention 841) is a guide for small water resource organizations, public agencies, and private engineers engaged in the design and the construction of small dams and retention reservoirs. The preface points out that the book is intended primarily as a guide to safe and economical practices for those concerned with small dams in public works programs in the U. S. It serves this purpose in three ways: (1) by providing engineers with information and data necessary for the proper design of small dams; (2) by giving specialized and highly technical knowledge in a form that can be used readily by engineers who do not specialize in this field; and (3) by simplifying design procedures for small earthfill dams. Only the more common types of small dams now being constructed are discussed: concrete gravity, earth-fill (rolled-type) and rock-fill. Emphasis is placed on the design of the common, rolled earthfill type. (Small dams are defined as earth-and rock-fill structures with heights less than 50 feet above streambed, and concrete dams on previous foundations whose "head" from headwater to tailwater does not exceed 20 feet.) In addition to discussions of the design of dams, spillways, and outlet works, the book contains

EXCESSIVE AIR TOOL MAINTENANCE?



The majority of air tool down time and maintenance cost can be traced directly to dirty compressed air. Rust, pipe scale and other foreign materials are picked up from the air system by the moving air stream. This entrained debris is a sure source of trouble if allowed to enter your air operated equipment.

An Adams Poro-Stone filter is scientifically designed for maximum separating efficiency. Centrifugal forces trap entrained solids and liquids in the exclusive interior shell slots. They then drain into the lower liquid chamber for periodic removal. The gas then is completely cleaned as it diffuses thru the minute voids of the Poro-Stone element.

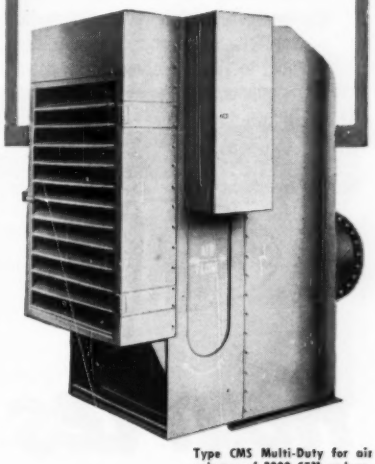
Throughout their operating range, they require only ½ PSI pressure drop—a negligible reduction from line pressure. Virtually no maintenance or servicing is required—assuring continued cost cutting, trouble free air.

Adams Poro-Stone air filters are available from stock in a wide range of sizes. Find out today how they can eliminate your compressed air problems. Write for Bulletin 117.

R. P. ADAMS CO., INC.

209 East Park Drive • Buffalo 17, New York

AAF Multi-Duty Filters Assure Clean Intake Air Automatically



Type CMS Multi-Duty for air volumes of 3000 CFM and up.

When your engines and compressors are protected by AAF Multi-Duty Self-Cleaning Filters, you *know* that intake air is *clean.*

Uniform air delivery, constant efficiency, low operating resistance and infrequent maintenance are "musts" for true dust protection. Multi-Duty measures up on every count because this filter keeps itself "fit" through continuous self-cleaning action.

Would you like more information? Write today for our 16 page illustrated catalog.

AAF herman nelson

American Air Filter

COMPANY, INC.

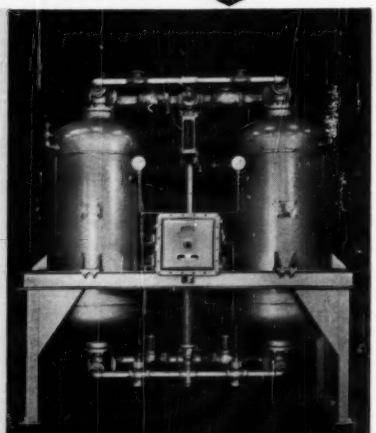
402 Central Avenue, Louisville 8, Kentucky

American Air Filter of Canada, Ltd., Montreal, P. Q.

REDUCE MAINTENANCE COSTS

Moisture and oil in your air system will result in costly repairs, down time, and even system failure. Moisture causes rust that clogs delicate sensing devices, slows down pneumatic controls, and in some cases, brings about total destruction of expensive equipment. Random oil in an air system forms sludges, gums and hard varnishes, causing instrumentation and control breakdown.

TRINITY



DESICCANT DRYER

Heat-Les

The Trinity Heat-Les dryer makes possible the driest air of all. This amazing dryer is being used in hundreds of industrial and military installations, and establishing new records for dependability, economy and performance.

- Dewpoints to -200°F.
- Low initial cost.
- No heaters to replace or power.
- No increase in air temperature.

Heat-Les dryers are available in many sizes, for all pressures, from 1 scfm to 5000 scfm. Larger volumes may be handled through combinations of units. Also, in complete, unitized dry air systems, including compressor, accumulator and instrumentation

• WRITE FOR COMPLETE DETAILS . . .

TRINITY

World leader in dry gas systems

Heat-Les Dryers • Heat-reactivated Dryers
Thermocouples and Thermowells

TRINITY EQUIPMENT CORPORATION, CORTLAND, NEW YORK

chapters on project planning, flood studies, foundations and construction materials, diversion during construction, and maintenance and operation. Appendices are provided on hydraulic computations, construction of embankment, concrete in construction and sample specifications. There are other supplementary features too. A total of 331 illustrations and engineering plates is included. 611 pages. Cost, $6.50.

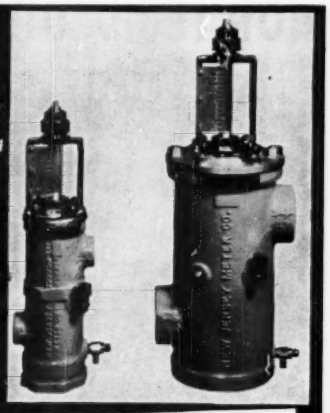
Small Plant Management: A Guide to Practical, Know-How Management (published by McGraw-Hill, 327 W. Forty-First Street, New York 36, N. Y.) was edited by W. A. MacCrehan, Jr., chairman of the Small Plant Committee, Management Division, Bendix Corporation. Prior to this he was an assistant professor in the department of administrative engineering, New York University. The book was prepared under the auspices of the management division of the American Society of Mechanical Engineers and is in its second edition. The volume is based on a systematic study of small plant activities in different industries that was conducted by the Small Plant Committee of the ASME. It provides a wealth of information on such aspects as plants as economic units, management tasks, solving important problems of management, and the future of the small plant. This revised edition has been updated but retains the original thought and context, achieving a practical balance between time-honored techniques and more modern devices for better management. Among the topics discussed are financing and banking, organizing the plant, principles of scientific management, and government interest in small plants. Written by experts in their respective fields, the chapters cover such areas as labor relations, sales planning and forecasting, and quality control in the small business. Information is also provided on how to fulfill legal requirements, do technical research, and how to obtain best sales. Included is a comprehensive check list to aid managers. 560 pages. Cost $10.50.

. . . oh, the devil with it."

TOOL-OM-ETERS
DRILL-OM-ETERS
The Pulsation Compensated
AIR METERS

5 Ranges Covering from 4 to 450 CFM

- SIMPLE AND PRACTICAL OPERATION
- RELIABLE AND DURABLE
- PORTABLE FOR FIELD TESTING
- ACCURACY ± 1%



New Jersey Air Meters measure the air consumption of any pneumatic tool, drill, motor, sand blast, or other pneumatic device or process. Air consumption is the "pulse" of the condition of air equipment. With New Jersey Air Meters you can select the most suitable equipment for your particular service, maintain this equipment in effective working condition and eliminate the "air-eaters" when they have become obsolete. KEEP YOUR PRESSURE UP AND YOUR AIR COST DOWN WITH SIMPLE, RELIABLE, PORTABLE, ACCURATE AND CONVENIENT NEW JERSEY AIR METERS. TECHNICAL BULLETINS AVAILABLE UPON REQUEST.

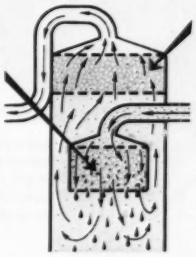
NEW JERSEY METER CO., INC.
344 Leland Avenue • Tel. PL. 6-8010
PLAINFIELD, NEW JERSEY

ANNOUNCING *King*
COMPRESSED AIR FILTERS
20 to 200 scfm flow capacity — ¼" to 2" pipe size

- **Give EXTRA-CLEAN AIR**
- **Go MONTHS WITHOUT MAINTENANCE**

..thanks to new kind of filtering action.
COALESCENCE is the secret:

1 **WET FILTER BED** in **Scrubber Cartridge** causes fog and mist to **COALESCE into large drops** that fall into sump. Takes out dirt, water and oil. Down-flow provides self-cleaning. **Lasts for months without maintenance.**



2 Dry **Polisher Cartridge** gives final cleaning. Scrubber Cartridge does 98% of the work, so Polisher also **lasts for months.**

Cartridges are disposable. One size fits all King Filters.

FREE CATALOG gives ALL the facts; lists 60 standard models. Write, wire or phone today for *Catalog 6000*.

KING ENGINEERING CORP.
3219 S. State St. Ann Arbor, Mich.
LIQUID LEVEL GAGES, MANOMETERS, ACCESSORIES–SINCE 1937

ADVERTISERS INDEX

Adams Company, Inc., R. P. 33

Air-Maze Corporation-
Subsidiary Rockwell-Standard Corp. 36

American Air Filter Co., Inc. 33

Anaconda Company, The ..... 3rd Cover

Armstrong Machine Works 31

Bethlehem Steel Company 5

Compressed Air Magazine Company 31

Conrader Company, Inc., R. 30

Dollinger Corporation 1

Electric Machinery Mfg. Company 6

Ingersoll-Rand Company ..... 4, 7, 28, Back Cover

King Engineering Corporation 35

Naylor Pipe Company 2

New Jersey Meter Co., Inc. 35

N. Y. & N. J. Lubricant Co. 36

Nugent & Company, Wm. W. 32

Schrader's Sons, Inc., A.—
Division Scovill Mfg. Co., Inc. ..... 2nd Cover

Trinity Equipment Corporation 34

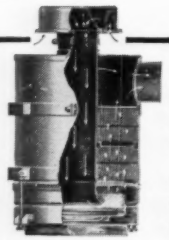
Editorial Index ..... Page 3

Great names—that made
scientific filtration possible!
Bernoulli's Principle: "The pressure of a fluid, either liquid or gas, decreases as velocity increases and increases as velocity decreases."
Daniel Bernoulli (1700-1782)

For more than 35 years, Air-Maze has specialized in the filtration of liquids and gases. And although Bernoulli lived more than 200 years ago, our engineers must take into account his discoveries in designing and developing new products for industry.

From crawler tractors to jet aircraft . . . from gear cases to modern air-conditioned buildings, Air-Maze filters are keeping equipment running better and longer by keeping it clean and free from damaging contaminants.

Shown below are representative products developed by Air-Maze engineers to solve specialized filtration problems. If your product involve any gas or liquid that moves, Air-Maze can help you.



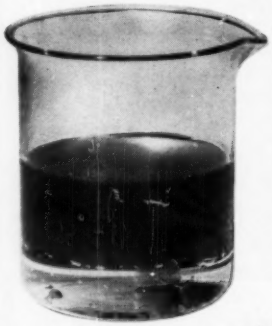
Air-Maze Oil Bath stack type air filters combine air intake protection with low pressure loss and longer intervals between servicing.

Only Air-Maze Dry Type air filters have the exclusive Dry-Maze washable, non-paper element. Lasts indefinitely.

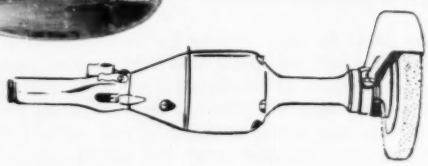
OTHER AIR-MAZE PRODUCTS: Air Filters • Liquid Filters Intake Silencers • Exhaust Spark Arresters • Breather Filters Oil Mist Eliminators

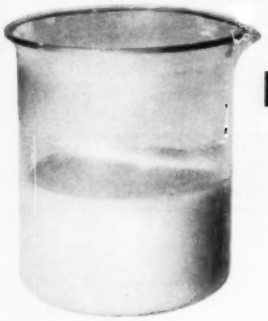
AIR-MAZE
CLEVELAND 28, OHIO
A SUBSIDIARY OF ROCKWELL-STANDARD
ROCKWELL R STANDARD

NON-FLUID OIL INCREASES AIR TOOL EFFICIENCY



Ordinary oil separates from water





NON-FLUID OIL
TRADE MARK REGISTERED

emulsifies with water

There is good reason why leading air tool manufacturers specify "NR" Grades of NON-FLUID OIL for initial run-in after assembly and recommend its continued use. They know that NON-FLUID OIL provides trouble-free lubrication while automatically protecting pneumatic tools against rusting, sticking and excessive wear.

Unlike ordinary oils and greases, "NR" Grades of NON-FLUID OIL absorb ever-present moisture in compressed air into the lubricant. Thus, despite air moisture content you are assured of perfect lubrication and complete protection against rusting, gumming or sticking.

When you lubricate air tools with "NR" Grades of NON-FLUID OIL, tool speeds automatically increase from 10% to 30%. You make the test. Write for free testing sample and Bulletin No. 550.

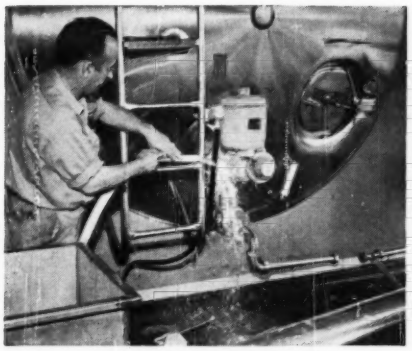
NEW YORK & NEW JERSEY LUBRICANT COMPANY
292 Madison Ave., New York 17, N. Y.

WORKS: NEWARK, N. J.
WAREHOUSES

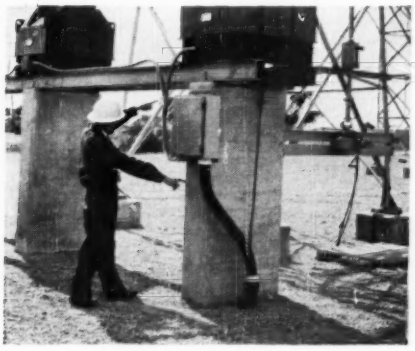
Birmingham, Ala.	Charlotte, N. C.	Springfield, Mass.	Providence, R. I
Atlanta, Ga.	Greensville, S. C.	Greensboro, N. C.	St. Louis, Mo.
Columbus, Ga.	Chicago, Ill.	Detroit, Mich.	

Also represented in principal industrial centers, including Pittsburgh, Pa., Cleveland and Cincinnati, Ohio.

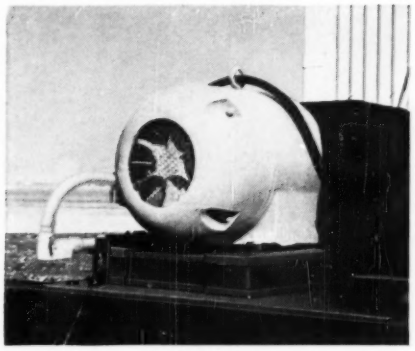
NON-FLUID OIL is not the name of a general class of lubricants, but is a specific product of our manufacturer. So called grease imitations of NON-FLUID OIL often prove dangerous and costly to use.



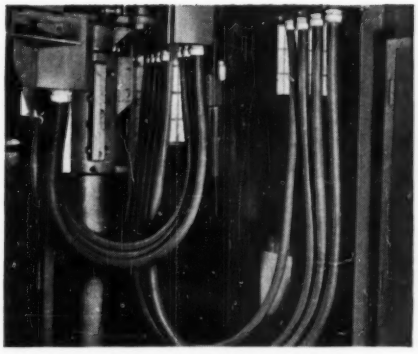
FOR WET SPOTS



MISALIGNMENT



OUTDOORS



MOVING CONNECTIONS

ON THE ROUGHEST JOBS SEALTITE PROTECTS WIRING

SEALTITE is a flexible *and* liquid-tight electrical conduit. It gives maximum protection to your wiring when it must connect moving parts, absorb vibration, follow machine contours, flex into U-bends, be easily maintained or be safeguarded between misaligned outlets.

It is being used successfully in wet locations, in tunnels, power plants, steel mills, canneries, chemical industries and in many outdoor applications. Sealtite comes in four types:

TYPE U.A. — TYPE C.S.A. Specifications for Type U. A. (Underwriters' Laboratories Listed) and Type C. S. A. (Canadian Standards Association Approved). Construction: flexible galvanized steel core, positive ground and tough extruded outer cover.

TRADE SIZE (Ins.)	INSIDE DIAMETER Min.	INSIDE DIAMETER Max.	OUTSIDE DIAMETER Min.	OUTSIDE DIAMETER Max.	Appr. Inside Bend Diam. (Ins.)	Approx. Shipping Wgt. (Lbs.) Per Std. Carton
3/8	.484	.504	.690	.710	6	60
1/2	.622	.642	.820	.840	7	70
3/4	.820	.840	1.030	1.050	10	70
1	1.041	1.066	1.290	1.315	12	90
1 1/4	1.380	1.410	1.630	1.660	15	70

TYPE E. F. † (Extra Flexible)—for machine tools and industrial equipment. (Meets J.I.C. requirements). Available in black, gray or white.

TYPE H. C. (Hot-Cold)—for temperatures from +221° F to −40° F.

TRADE SIZE (Ins.)	INSIDE DIAMETER Min.	INSIDE DIAMETER Max.	OUTSIDE DIAMETER Min.	OUTSIDE DIAMETER Max.	Appr. Inside Bend Diam. (Ins.)	Approx. Shipping Wgt. (Lbs.) Per Std. Carton
3/8	.485	.505	.690	.710	4	60
1/2	.620	.640	.820	.840	5	60
3/4	.815	.835	1.030	1.050	5	70
1	1.030	1.055	1.290	1.315	7	60
1 1/4	1.370	1.395	1.635	1.660	8	80
1 1/2	1.575	1.600	1.875	1.900	11	55
2	2.020	2.045	2.350	2.375	14	75
2 1/2	2.480	2.505	2.850	2.875	19	105
3	3.070	3.100	3.470	3.500	23	80
4	4.000	4.040	4.460	4.500	27	105

Commercial tolerances apply on above figures.

ELECTRICAL WHOLESALERS stock Sealtite. Buy it in long, random lengths on nonreturnable reels, at no extra cost. Available in sturdy cartons that are easy to store and carry to the job. Liquid-tight connectors also are available from wholesalers' stocks. For information write: Anaconda Metal Hose, Box 791, Waterbury 20, Connecticut. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario.

59142GR-1-L

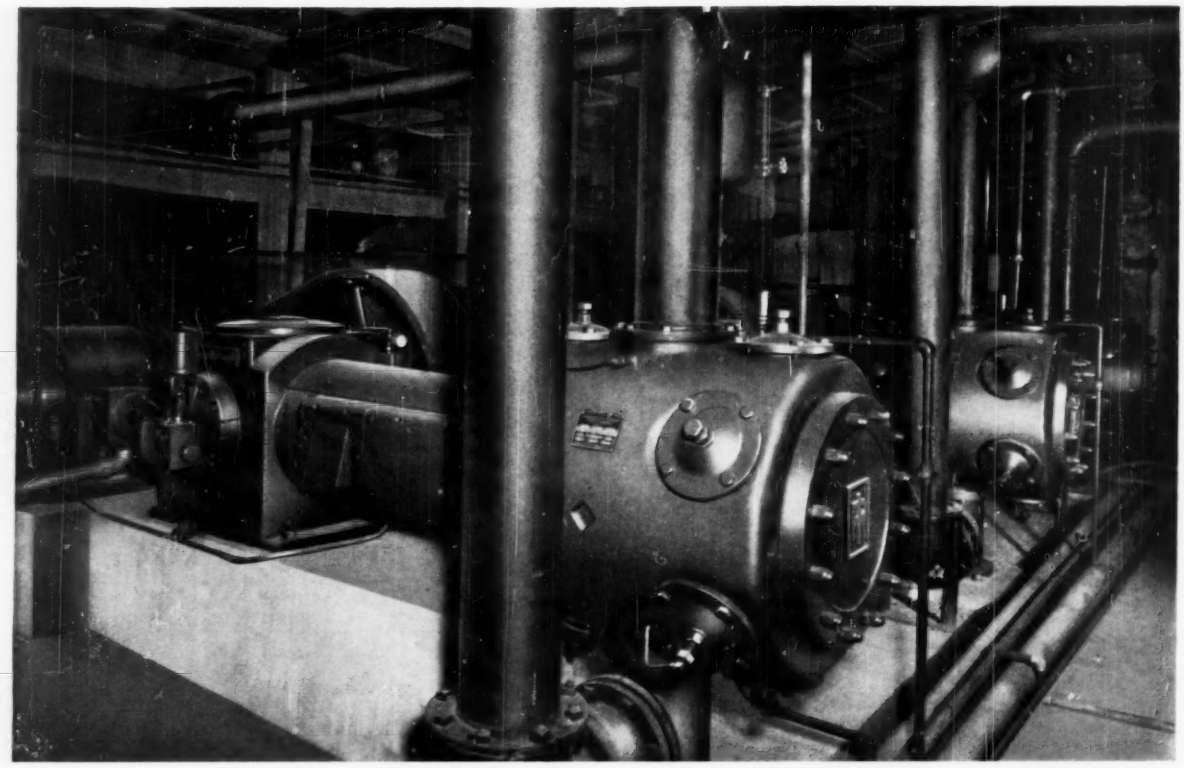
CUTAWAY SECTION of Type U.A. Sealtite shows tough polyvinyl chloride jacket over flexible galvanized steel core. Copper conductor wound spirally inside conduit gives positive ground.

Insist on the conduit marked

SEALTITE®

Flexible, Liquid-Tight Conduit

an **ANACONDA®** *product*



Ingersoll-Rand air power shoves tunnel through 4 miles of clay

A new water tunnel, built to meet the growing needs of the Detroit area, has been driven through 4 miles of clay by air power *alone*.

It's nothing new for compressed air to power rock drills and other equipment and to pressurize a tunnel. But on the Wayne County tunnel project, air power handled *every* job. An Ingersoll-Rand air motor powered the hydraulic system which forced the tunnel shield ahead, and when boulders blocked the way they were removed with air-powered clay diggers. I-R air motors handled the concrete liner forms, and I-R air-powered concrete vibrators were also used. Much of the air power was supplied by an Ingersoll-Rand two-stage compressor.

The tunnel was pressurized by the three Ingersoll-Rand ESH 25-psi compressors shown above. Their low headroom design simplified installation, and their exceptionally low maintenance held down the "overhead", too. These I-R compressors have many extra-value features not found in other makes: sealed frame construction which keeps out dust, and never has to be opened because running parts *never need adjustment;* full-floating aluminum bearings; full filtered pressure lubrication; and Ingersoll-Rand's famous air-cushioned Channel Valves with their unbeatable performance records.

Ingersoll-Rand Air Power can help your job, too. Your Ingersoll-Rand representative has new facts on what economy *really* means. Call him today.

Only I-R compressors have Channel Valves

Known for high efficiency, quiet operation and exceptional durability. Entirely different. Each valve is a combination of rigid stainless-steel channels and bowed leaf springs, with trapped-air spaces which cushion action, prevent impact.

Ingersoll-Rand

87A1 11 Broadway, New York 4, N.Y.

The World's Most Comprehensive Compressor Experience